## Technical Memorandum

# FINAL

# Water Quality Monitoring and Assessment of the Nantucket Island-Wide Estuaries and Salt Ponds Update 2013

**To:**

**Town of Nantucket**
**Marine and Natural Resources Department**
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The Technical Memorandum on the 2013 Nantucket Water Quality Monitoring Program is organized consistent with previous SMAST water quality monitoring summaries (2010 and 2012) as follows:

1. Overview

    - Background
    - Need for a Monitoring Program

2. Summary of Sampling Approach for each of Nantucket's estuaries and salt ponds:

    - Nantucket Harbor
    - Madaket Harbor
    - Long Pond
    - Hummock Pond
    - Miacomet Pond
    - Sesachacha Pond

3. Results of Sampling: Summary of Water Quality Results

    - Review of and comparison to historical data

4. Trophic State: Water Quality/Eutrophication Status

5. Recommendations for Future Monitoring

## Overview

***Background:*** Coastal salt ponds and estuaries are among the most productive components of the coastal ocean. These circulation-restricted embayments support extensive and diverse plant and animal communities providing the foundation for many important commercial and recreational fisheries. The aesthetic value of these systems, as well as the freshwater ponds of a town, are important resources to both residents and the tourist industry alike. Maintaining high levels of water quality and ecological health in these aquatic systems (fresh and marine) is fundamental to the enjoyment and utilization of these valuable resources for all coastal communities.

Nutrient over-enrichment is the major ecological threat to water quality in the salt ponds and embayments within the Town of Nantucket, primarily via ecological degradation which results when nutrient inputs exceed the assimilative capacity (also called critical nutrient threshold) of the system for new nutrient inputs. Of the various forms of pollution that threaten coastal waters (nutrients, pathogens and toxics), nutrient inputs are the most ubiquitous, insidious and difficult to control. This is especially true for nutrients originating from non-point sources, such as nitrogen and phosphorous transported in the groundwater from on-site septic treatment systems. On-site septic treatment systems continue to be the primary mechanism for waste disposal within the Madaket Harbor/Long Pond, Hummock Pond, Miacomet Pond and Sesachacha Pond watersheds. Nantucket Harbor is in a somewhat different situation as its watershed has extensive

sewering with disposal of treated effluent outside of the watershed. Nevertheless, the nutrient characteristics and ecological health of that system must be monitored given the shellfish fishery and touristic enterprises that depend on the water quality of Nantucket Harbor. Since nitrogen and phosphorous are both natural components of estuarine and pond systems, it is important that management allow for the natural capacity of these systems to absorb watershed nutrient inputs. Through the coupling of monitoring data to the Massachusetts Estuaries Project (MEP) watershed loading analysis developed in collaboration with the Coastal Systems Program (CSP), the most cost-effective management strategies can be found to protect these valuable aquatic environments. Moreover, as nutrient load reduction strategies become implemented across the Island and in specific estuarine watersheds, maintaining the regular monitoring of nutrient related water quality in the estuaries is critical for answering questions related to whether or not a particular implementation approach is having a positive effect and in some cases if full implementation is needed.

***Need for a Monitoring Program:*** Conserving and/or restoring the environmental health of coastal embayments and freshwater ponds is achievable, but only through proper management of the waters and watersheds to each. Managing environmental health requires a quantitative understanding of the biological and physical processes which control nutrient related water quality within a specific basin and the role of watershed inputs in the nutrient balance of the receiving waters. An essential step in managing these fresh and saltwater systems is to monitor their water quality. The results of a long-term monitoring effort are needed to: 1) determine the status and trend of ecological health of each system, 2) to assess the need for management action and, when coupled with higher-end ecological data, 3) to support the development of site-specific management plans.

As in previous years, 2013 water quality monitoring of Nantucket's fresh and saltwater systems was focused on summer-time conditions, as the warmer months typically have the lowest water quality conditions, which are the target of resource management. The Town of Nantucket has a long history of monitoring of its aquatic systems, generally by the Nantucket Marine and Coastal Resources Department, (and currently the Natural Resources Department effective 2012) to support the protection and management of the natural resources of the Town of Nantucket. This effort has also supported nutrient related estuarine analyses by the Massachusetts Estuaries Project for restoration/protection of all the coastal systems of southeastern Massachusetts and specifically on the island of Nantucket. Over the past nine years, the MEP has established the estuarine specific nitrogen thresholds for all of the estuaries of Nantucket including most recently, Hummock Pond. As such, the Town of Nantucket has the estuarine specific nutrient related restoration targets for all the estuaries of the Island and can now actively focus on ascertaining the efficacy of the wide range of implementation measures available to reduce nitrogen concentrations in the estuaries to meet the MEP Thresholds. It is for this reason that it becomes increasingly important to maintain a consistent water quality monitoring approach that extends the water quality monitoring record and against which the effectiveness of hard and soft solutions can be measured.

Water quality monitoring programs, like Nantucket's, can also maximize the value of their results by structuring their sampling and analysis program, such that results can be cross

compared to water quality monitoring data collected across the Island of Nantucket and more broadly throughout the region. In this manner, inter-ecosystem comparisons can be made to better assess system health/impairment and function and formulate appropriate nutrient management strategies. This allows individual towns to directly benefit from lessons learned throughout the wider region.

## Summary of Sampling Approach

***Monitoring Project Team:*** To address the present nutrient related ecological health issues of the salt ponds and embayments within the Town of Nantucket and to provide necessary information with which to develop policies to protect and/or remediate these systems with regard to nutrient inputs, a long-term municipally coordinated monitoring effort was established and coordinated through the Nantucket Marine and Coastal Resources Department in early 2000 which continued through 2007. The program was interrupted in 2008 and 2009 due to funding constraints. In 2010 it was determined that the Nantucket Island-wide Water Quality Monitoring Program should be resumed with support from the Coastal Systems Program at the University of Massachusetts-Dartmouth, School for Marine Science and Technology (SMAST). Water quality monitoring was completed during the summer of 2011 by another group, however, to maintain consistency with water quality monitoring procedures and assays from all the previous years other than 2011, water quality monitoring in 2012 and 2013 was completed by the Coastal Systems Program located at the University of Massachusetts-Dartmouth, School for Marine Science. The Coastal Systems Program has also been responsible for the development and coordination of the majority of the estuarine and pond water quality monitoring across southeastern Massachusetts, Cape Cod and the Islands as well as the analysis of all the samples collected and synthesis of the resulting water quality data. A such, the CSP is able to leverage this comprehensive water quality database to further evaluate results obtained from the Nantucket Island-wide monitoring program.

CSP scientists focused primarily on the analysis of samples collected from the effort, data analysis and program coordination while the Nantucket Natural Resources Department focused primarily on field sampling and data collection on physical parameters. Both participated in the compilation of field and laboratory data to provide an ecological overview of water quality conditions within each of the systems monitored. The goals of the monitoring program were to:

(1) determine the present (2013) ecological health of each of the main salt ponds and estuaries within the Town of Nantucket,

(2) gauge (as historical data allows) the decline or recovery of various salt ponds and embayments over the long-term (also part of TMDL compliance), and

(3) provide the foundation (and context) for detailed quantitative measures for proper nutrient and resource management, if needed.

This latter point (3) is critical for restoration planning should a system be found to be impaired or trending toward impairment.

***Water Quality Program Description:*** As was the case in 2010 and 2012, sampling took place during the warmer summer/early fall months (May-September) of 2013, the critical period for environmental management. Samples were collected from 6 systems (Figures 1, 2, 3, 4 and 5) on dates ("events") following the schedule presented in Table 1a (2010) and Table 1b (2012) and Table 1c (2013). Samples collected in 2013 were obtained from the same sampling stations locations and the same number of depths as in 2010 and 2012 to ensure cross comparability. It should be noted that the Town of Nantucket did undertake water quality monitoring in 2011, however, those samples were analyzed by a lab other than the Coastal Systems Laboratory at the UMASS School for Marine Science and Technology. As CSP scientists could not be certain of analytical protocols and procedures utilized for the processing of samples collected in 2011, the results have not be integrated into the comparison of 2010, 2012 and 2013 water quality data. As was done for the 2012 Water Quality Summary Technical Memo, the 2011 water quality data is presented in tabular form in Appendix A for the sake of having all four years of data in one document for easier cross referencing.

The Nantucket Natural Resources Department oversaw the sampling and all samplers who were involved were given refresher "training" by CSP staff to meet QA requirements. The physical parameters measured in the estuaries included: total depth, Secchi depth (light penetration), temperature, conductivity/salinity (YSI meter), general weather, wind speed and direction, dissolved oxygen levels and observations of moorings, birds, shellfishing and unusual events (fish kills, algal blooms, etc). Laboratory analyses for estuaries included: salinity, nitrate + nitrite, ammonium, dissolved organic nitrogen, particulate organic carbon and nitrogen, chlorophyll-*a* and pheophytin-*a* and orthophosphate. For the 2010 sampling season, freshwater streams were sampled and parameters assayed included: specific conductivity, nitrate + nitrite, ammonium, dissolved organic nitrogen, particulate organic carbon and nitrogen, chlorophyll-*a* and pheophytin-*a,* orthophosphate and total phosphorus. As in the summer of 2012, the water quality monitoring undertaken in 2013 was focused entirely on estuarine stations. In addition, 32 sets of field duplicates were taken as part of the field sampling protocol for QA analysis. Data were compiled and reviewed by the laboratory for accuracy and evaluated to discern any possible artifacts caused by improper sampling technique. In addition, some samples were rerun to confirm prior results. As a point of comparison, the sampling schedule for 2010, 2012 and 2013 are provided below in Tables 1a,1b,1c.

**Table 1a.** Sampling Schedule for 2010 Nantucket Water Quality Monitoring Program

| Month | Nantucket Harbor | Madaket Harbor | Long Pond | Sesachacha Pond | Miacomet Pond | Hummock Pond | Streams |
|---|---|---|---|---|---|---|---|
| Jan | | | | | | | |
| Feb | | | | | | | |
| Mar | | | | | | | |
| April | | | | | | | |
| May | May 18 | May 20 | May 19 | May 26 | May 26 | May 25 | |
| June | June 2, 17 | June 3, 15 | June 17 | June 24 | June 24 | June 29 | June 28 |
| July | July 1, 15, 30 | July 16, 27 | July 29 | July 26 | July 26 | July 28 | |
| August | Aug. 13 | Aug. 12, 30 | Aug. 11 | Aug. 26 | Aug. 26 | Aug. 27 | |
| September | Sept. 1, 14 | Sept. 13 | Sept. 15 | Sept. 23 | Sept. 23 | Sept. 28 | |
| October | Oct. 21 | | | | | | |
| November | | | | | | | |
| December | | | | | | | |
| **Totals** | **10** | **8** | **5** | **5** | **5** | **5** | **1** |

**Table 1b.** Sampling Schedule for 2012 Nantucket Water Quality Monitoring Program

| Month | Nantucket Harbor | Madaket Harbor | Long Pond | Sesachacha Pond | Miacomet Pond | Hummock Pond |
|---|---|---|---|---|---|---|
| Jan | | | | | | |
| Feb | | | | | | |
| Mar | | | | | | |
| April | | | | | | |
| May | May 29 | | | | | |
| June | June 7, 28 | June 12 | June 25 | June 20 | June 20 | June 27 |
| July | July 9, 26 | July 11 | July 24 | July 19 | July 19 | July 31 |
| August | Aug 7, 22 | Aug 8 | Aug 21 | Aug 23 | Aug 23 | Aug 24 |
| September | Sept 6 | Sept 7 | Sept 25 | Sept 25 | Sept 27 | Sept 26 |
| October | | | | | | |
| November | | | | | | |
| December | | | | | | |
| **Total Events** | **8** | **4** | **4** | **4** | **4** | **4** |

**Table 1c.** Sampling Schedule for 2013 Nantucket Water Quality Monitoring Program

| Month | Nantucket Harbor | Madaket Harbor | Long Pond | Sesachacha Pond | Miacomet Pond | Hummock Pond |
|---|---|---|---|---|---|---|
| Jan | | | | | | |
| Feb | | | | | | |
| Mar | | | | | | |
| April | | | | | | |
| May | | May 28 | | May 22 | May 22 | May 21 |
| June | June 13, 25 | June 12 | June 4,26 | June 5 | June 5 | June 6 |
| July | July 17, 30 | July 16 | July 10 | July 9 | July 9 | July 2 |
| August | Aug 13, 28 | Aug 12 | Aug 21 | Aug 21 | Aug 6 | Aug 14 |
| September | Sept 9 | Sept 10 | Sept 24 | Sept 19 | Sept 24 | Sept 18 |
| October | | | | | | |
| November | | | | | | |
| December | | | | | | |
| **Total Events** | **7** | **5** | **5** | **5** | **5** | **5** |

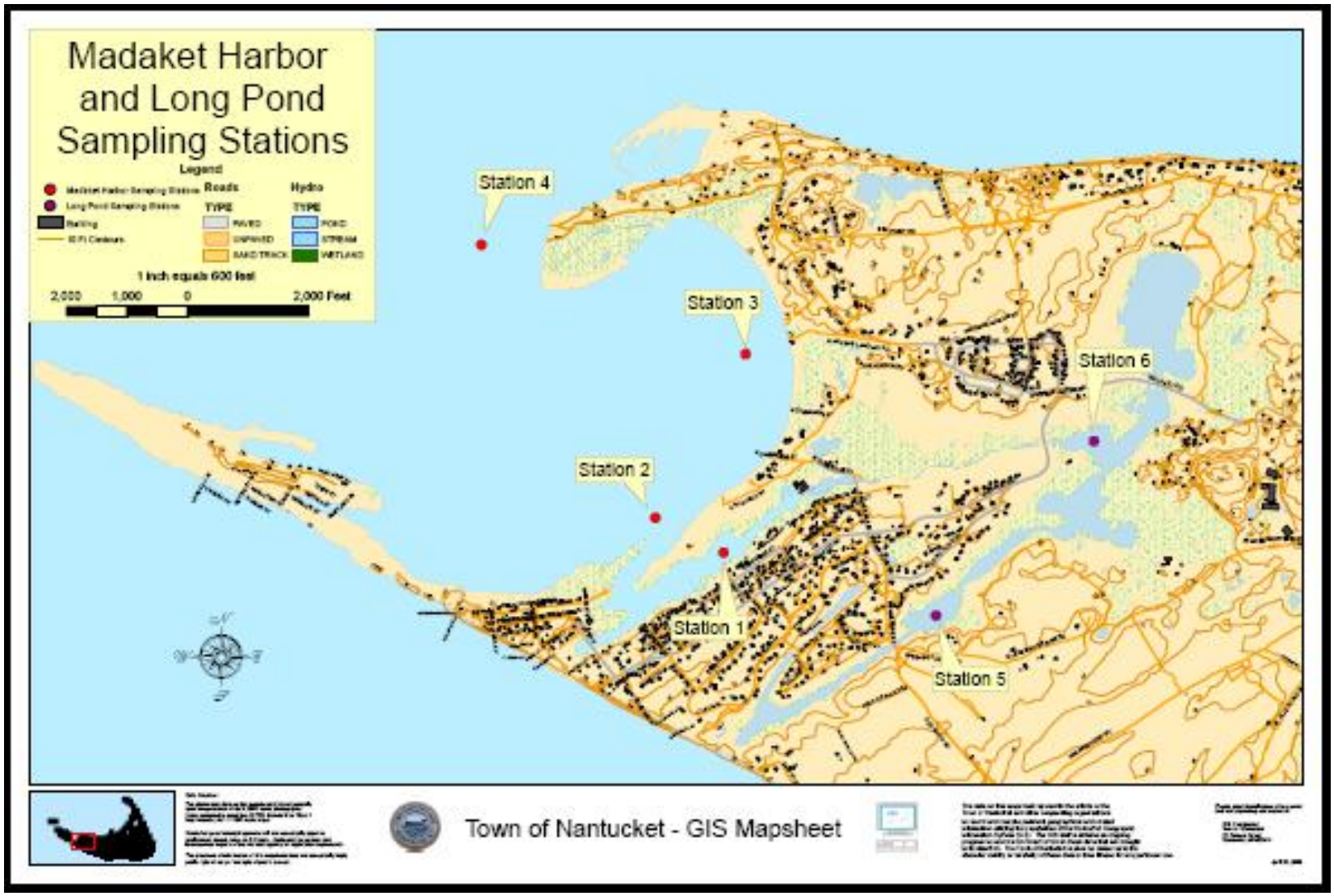



**Figure 1.** Madaket Harbor and Long Pond sampling stations 2010, 2012 and 2013.

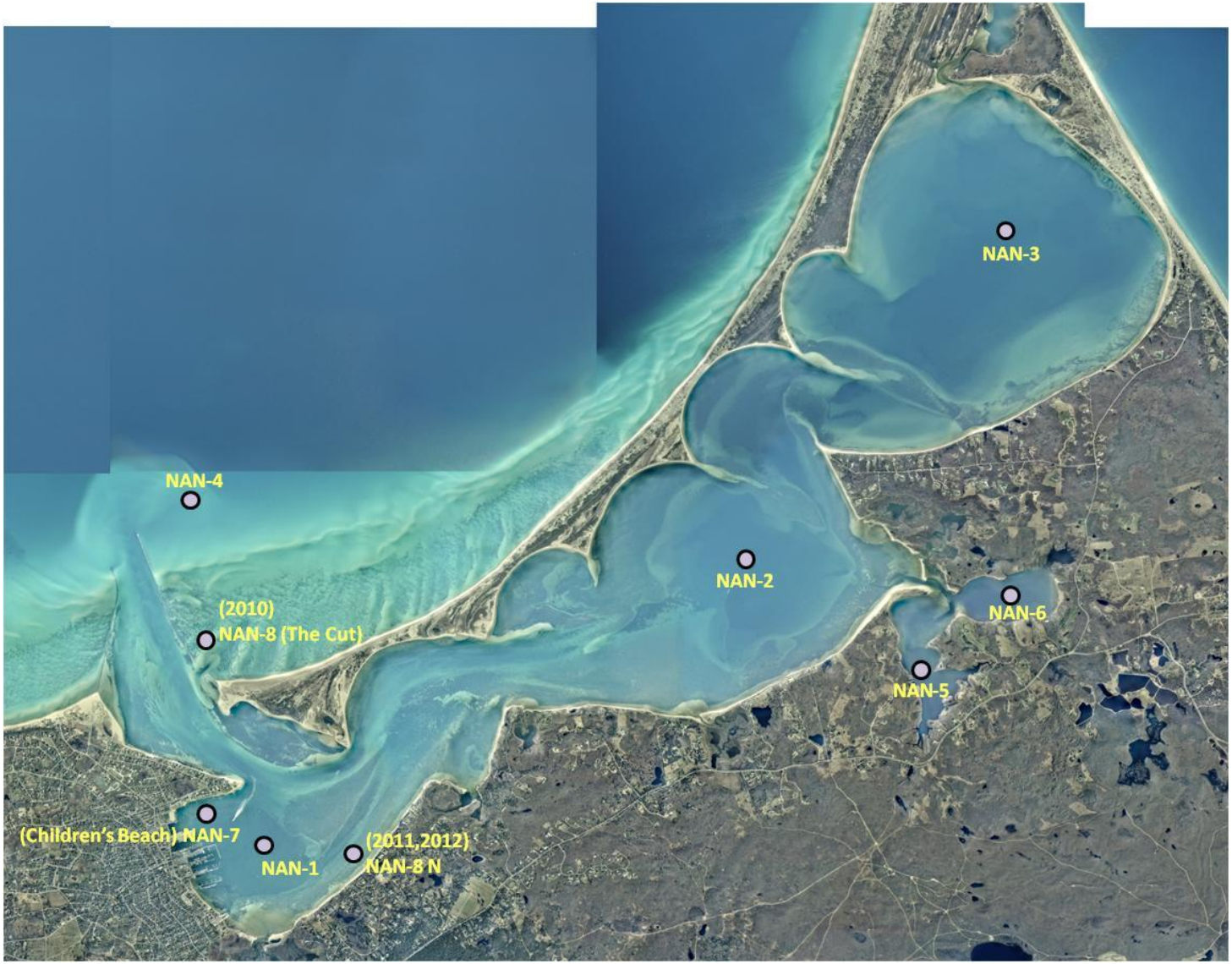



**Figure 2.** Nantucket Harbor sampling stations 2013. Station NAN-8 (the cut) was only sampled in 2010 and location changed in 2011 and 2012.

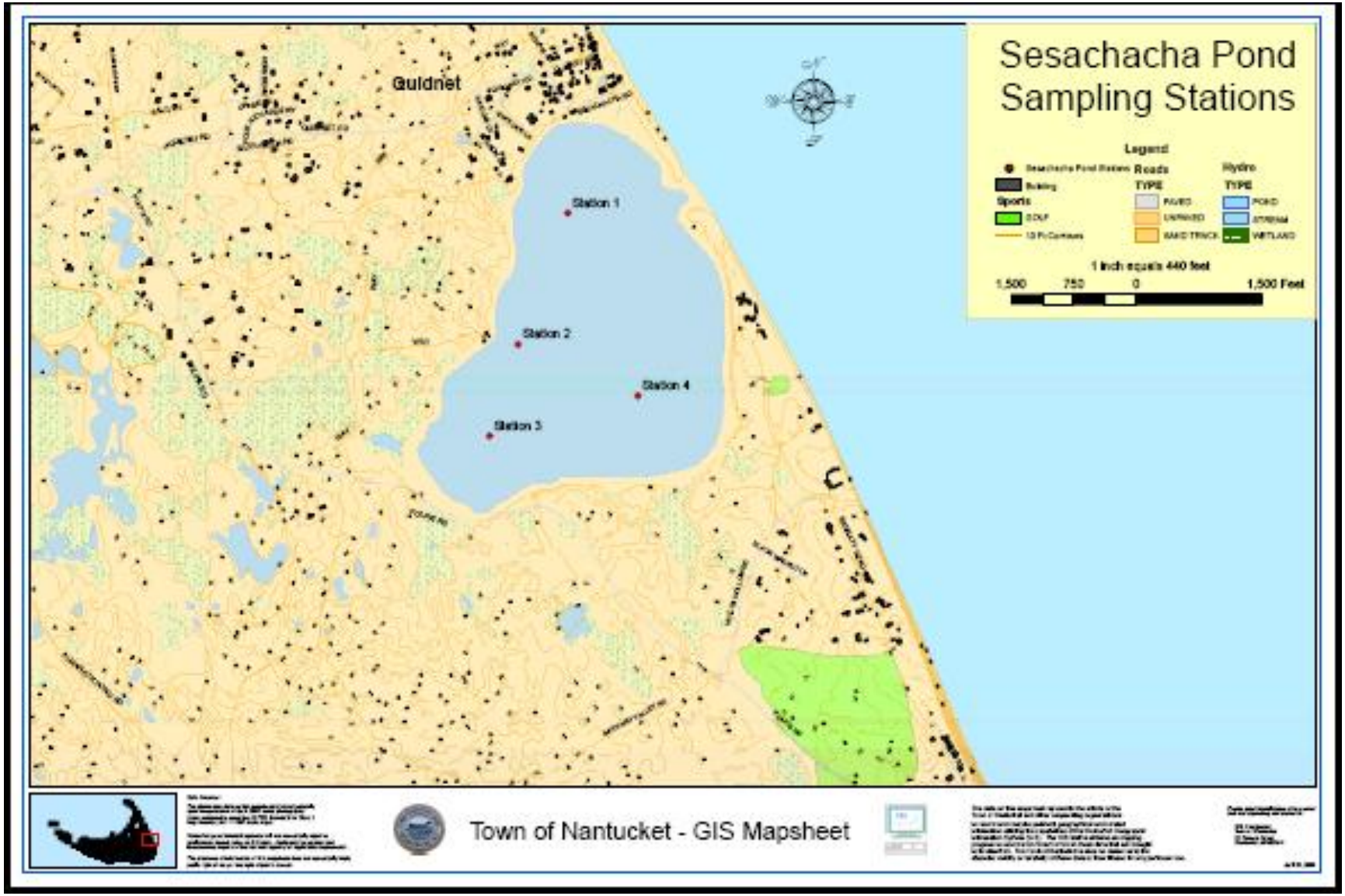


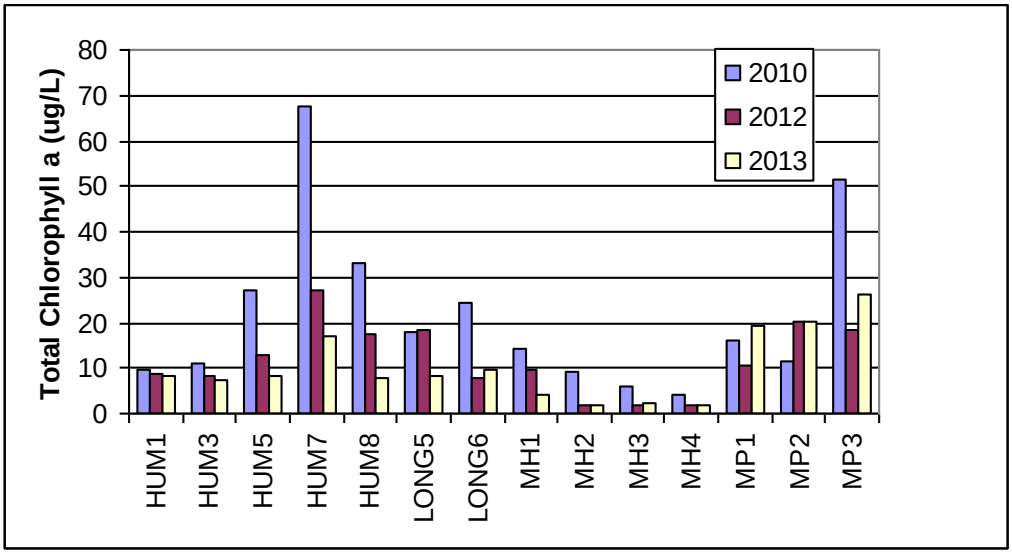

**Figure 3.** Sesachacha Pond sampling stations 2010, 2012 and 2013.


**Figure 4.** Hummock Pond sampling stations 2010, 2012 and 2013.

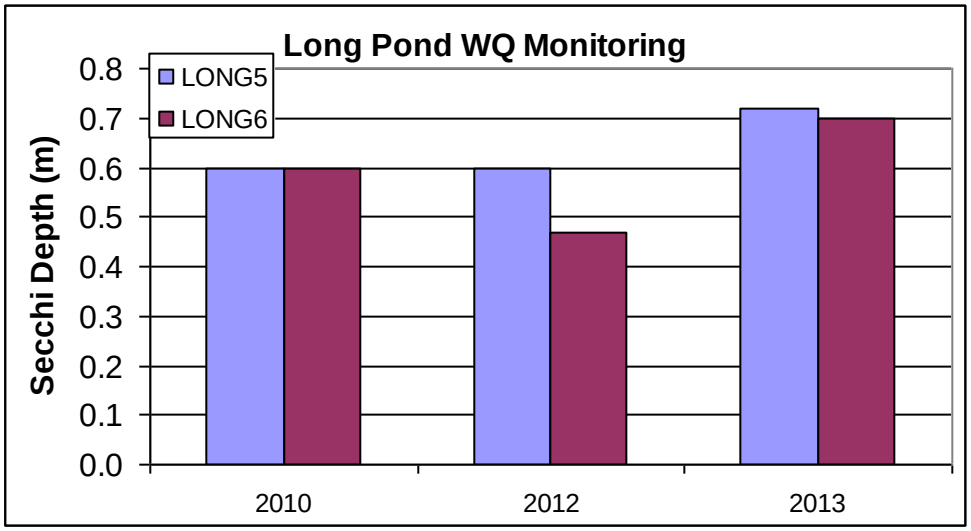

**Figure 5.** Miacomet Pond sampling stations 2010, 2012 and 2013.

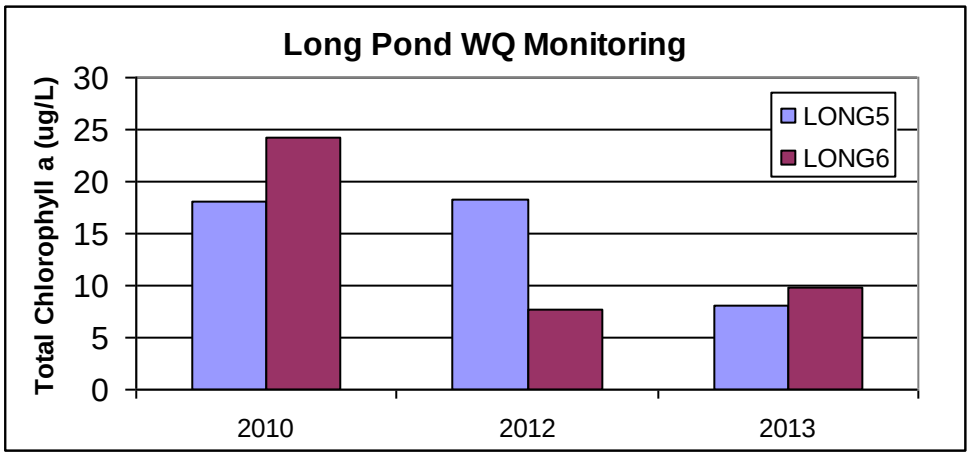
**Summary of 2013 Water Quality Results for Nantucket Sampling**

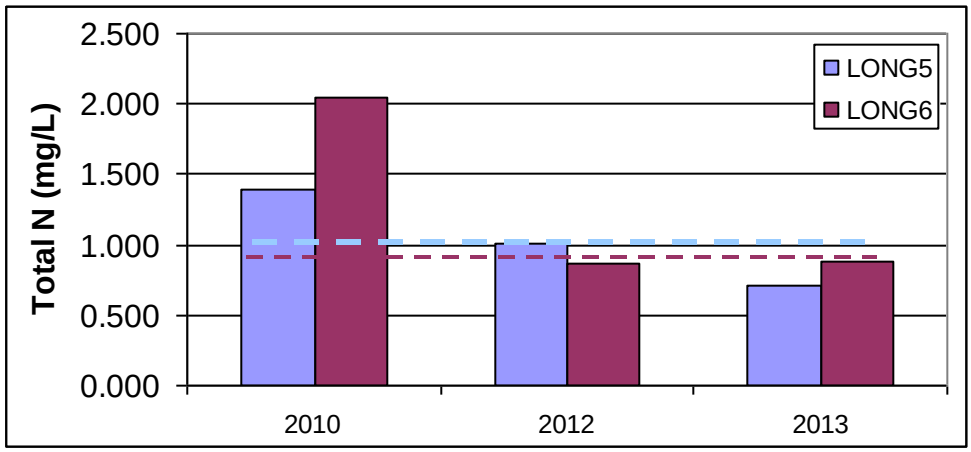
While there were some localized areas of interest (Sesachacha and Long Ponds, see below), the overall trends in water quality observed in 2013 follow and expand the pattern observed in 2010 and 2012. Water samples collected from May through September in the estuarine systems indicate that organic nitrogen (dissolved + particulate) dominates the Total Nitrogen pool (79%-95% overall, 87%-97% 2013 alone), while bio-available nutrients in the form of nitrite and nitrate (NOx) and ammonium ($NH_4$) account for only 5%-21% (3%-13%, 2013) of the Total Nitrogen pool (Table 2a,b,c, Figure 6). These results are typical for estuarine systems throughout New England, where nitrogen is the nutrient responsible for eutrophication and therefore the nutrient critical for management. The predominance of organic nitrogen in the Total Nitrogen (TN) pool in these systems would indicate that they are effectively converting the bioavailable inorganic forms of nitrogen into organic forms (e.g. phytoplankton). Where tidal flushing is effective, much of this particulate matter along with dissolved nutrients is washed out of the system resulting in good water clarity as evidenced by the greater secchi depth readings in the main basins of Nantucket Harbor and Madaket Harbor in 2013 (Table 2a), as noted in prior years as well (Table 2b,c). Consistent with the water clarity, corresponding Chlorophyll-*a* pigment concentrations were lowest (2-4 ug/L) in these well flushed systems (Table 2a,b,c). Where tidal flushing is more restricted in Long, Hummock and Miacomet Ponds (0.4-1.2 m) and in the improving Sesachacha Pond (2 meters), these poor to moderate levels of water clarity are consistent with the chlorophyll-*a* pigment concentrations that are significantly higher, 9 ug/L, 8-17 ug/L, 20 ug/L and <5 ug/L, respectively (Table 2a). These general patterns were also observed in prior years monitoring results. It should be noted that 2012 generally showed lower phytoplankton biomass (as indicated in the Total Pigment column of Tables 2b and 2c) within each estuary when compared to 2010 summertime conditions. The multi-year results clearly show that 2010 was a poor water quality year as seen in total nitrogen and the magnitude of the blooms in portions of Hummock, Long and Miacomet Ponds with Madaket Harbor shown for high water quality reference (see figure nearby). Note that Long Pond chlorophyll-*a* levels are significantly lower in 2012 and 2013 than 2010. The level of variation is common and underscores the need for multi-year monitoring to establish trends.



Total Nitrogen levels for each estuarine system in 2010 and 2012 were within 3%-9% of each other, except for the stations in Long Pond. Additional analysis of Long Pond trends reveals that the improving water quality is seen across key water quality metrics as seen in the following graphic.




Long Pond showed significantly lower TN levels (~40%) in 2012 versus 2010. Levels at Station 5 continued to decline from 2012 to 2013 and held steady or improved again in 2013. This is a trend that the monitoring program should follow closely. It is necessary to determine if this represents a real reduction (possibly associated with watershed

activities) or merely a natural inter-annual variation. Town activities at the landfill represent one potential watershed activity warranting further examination as the 2013 summer results follow the trend in 2010 and 2012 (see figure above). It should be noted that a three (3) point trend may not continue to hold, but it is encouraging as the Town has made significant strides toward reducing nitrogen inflow to Long Pond from its adjacent land fill.

Average Total Nitrogen values in 2013 [2012, 2010] were generally similar: 0.795 [0.94,1.75] mg/L in Long Pond, 0.900 [0.923, 0.944] mg/L in Hummock Pond, 0.962 [0.919, 0.886] mg/L in Miacomet Pond, 0.669 [0.704, 0.639] mg/L in Sesachacha Pond, all relatively poorly flushed compared to Nantucket and Madaket Harbors. Average TN levels in all 4 ponds are significantly higher than average values in the "offshore" stations NAN 4 and MH4 which average 0.317 [0.344, 0.302] and 0.278 [0.297, 0.285] mg/L, respectively (Tables 2a, 2b, 2c, Figures 1, 2).
Average 2013 [2012, 2010] TN level in Madaket Harbor (Stations 1-3, not including Station 4, offshore) was 0.404 [0.485, 0.462] mg/L, compared to the off-shore Station 4 0.278 [0.297, 0.285] mg/L. Average TN in Nantucket Harbor (all Stations except Station 4, offshore) averaged 0.348 [0.395, 0.369] mg/L, compared to the off-shore Station 4 (Tables 2a, 2b). It should be noted that the [2010] value includes station NAN-8 (the cut) whereas the 2013 and 2012 value includes station NAN-8N which was relocated into the Harbor refer to Figure 2 for station location). That may be a reason the 2013 and 2012 average TN concentration is slightly higher than the 2010 value. TN concentrations in the 6 streams adjacent to Nantucket Harbor in 2010 ranged from 0.565 mg/L in Stream 8 to 2.139 mg/L in Stream 6B (Table 2b). In spite of the high TN concentrations in these 6 streams and the likely high TN loads that these streams contribute to the Harbor, tidal flushing and dilution with lower concentration Harbor waters seems to be an effective mechanism to keep TN levels in the main body of the Harbor relatively low (Table 2a,b,c; Figure 2). It should be noted that the stream stations were not sampled in 2012 or 2013. TN concentrations in East Polpis Harbor, 0.401 [0.438, 0.484] mg/L and West Polpis Harbor 0.385 [0.431, 0.419] , which is fed by the high TN levels in Streams 4, 6B and 6C, are somewhat higher than the levels in the main Harbor, but still significantly lower than the levels in the streams themselves (Table 2, Figure 2).

Relative to the 2013, 2012 and 2010 data sets, results indicate that within Long, Hummock and Miacomet ponds, there is a general gradient of nutrient (N and P) and chlorophyll concentrations from high levels in the upper, more enclosed and poorly flushed reaches of the estuaries to lower concentrations closer to the outlets where flushing is more effective (Figure 6). In Sesachacha Pond, there is no noticeable nutrient or chlorophyll gradient among any of the 4 Stations (Figure 6, Table 2) because of the closed nature of the pond and its shape, it's mixing being more like a freshwater lake. Madaket Harbor shows a significant nitrogen gradient (and associated metrics) from Station 1 in Hither Creek (which receives discharge from Madaket Ditch), and is relatively poorly flushed, out to Station 2 in the Harbor with further decreases out to the off-shore Station 4. In Nantucket Harbor, there is a very small nutrient gradient from Wauwinet at the Head of the Harbor and the more enclosed Polpis stations out to the entrance at Stations 8 and 4 (Figure 6, Table 2). There is also a chlorophyll gradient with the highest concentrations at the 2 Polpis Stations (5 and 6), decreasing in the main Harbor and out to the off-shore Station 4 (Table 2).

In reviewing the 2013, 2012 and 2010 dissolved oxygen data, it does not appear that there is sufficient temporal sampling in any one year to capture the critical minimum oxygen levels. Therefore, while assessment of the oxygen levels in each estuary was performed, it will be necessary to conduct a multi-year composite analysis once sufficient data has been collected. It is also possible to strengthen the dissolved oxygen data base in specific estuarine basins as each years monitoring results are assessed. We have made some recommendations which we have noted at the end of the discussion section.

***Comparison of the 2012 and 2010 data with historical data:*** At all sites, historical TN levels from previous years of sampling were compared to 2012 and 2010 TN concentrations. Historical data presented here are from the Massachusetts Estuaries Project (MEP) reports for Nantucket Harbor, Sesachacha Pond and Madaket Harbor/Long Pond. Historical data for Hummock Pond 2007 and for Miacomet Pond 2005 are from the Annual Reports by the Nantucket Marine and Coastal Resources Department. Not all sites sampled historically were sampled in 2010 but those that were are compared to the historical data in Tables 3 through 6. A similar analysis was not performed for 2013 as it was similar to 2012 results in almost all metrics.

Both the 2012 and 2010 Nantucket Harbor TN data generally compare well with historical data from the same or adjacent sites sampled by both SMAST and the Town from 1988 through 2005 (Figure 7, Table 3). Not all of the historical sites were sampled in 2010 (Table 3). At Station Town 3, the historical mean for TN was 0.401 $\pm$ 0.115 mg/L while the 2012 and 2010 TN values were 0.411 and 0.392 mg/L, respectively. In East Polpis Harbor the historical mean is 0.362 $\pm$ 0.112 mg/L while the 2012 [2010] values were 0.484 [0.438] mg/L. In West Polpis, the historical mean is 0.388 $\pm$ 0.119 mg/L similar to that in East Polpis. The 2012 [2010] values for TN were 0.419 [0.431], only slightly lower than the value in East Polpis. In general, TN levels in 2012 were slightly higher than 2010, but the differences were not significant.

In Sesachacha Pond, only Station 1 was available for comparison (Figure 8). The historical mean for TN was 1.197 $\pm$ 0.078 mg/L while both 2012 and 2010 TN levels were similar to each other but significantly lower than historically at 0.678 and 0.684 mg/L (Table 4). The continued apparent lower TN level in Sesachacha Pond versus historic levels is a critical finding, as relates to improvement of pond resources and the Town's need to document water quality and habitat improvement in this system. While it takes multiple years to document "restoration" the consistency of results in 2010 and 2012 provides a solid basis for moving forward with the third year of documentation (i.e. summer 2013).

In Madaket Harbor only MEP M11 and Town 1 were comparable sites. TN values agreed very well here. The historical mean was 0.620 $\pm$ 0.215 mg/L at M11 while the 2012 and [2010] values were 0.655 [0.626] mg/L (Table 5). In 2012 and 2010 Stations 2 and 3 were distributed throughout the harbor between historical stations 3 and 10, and 10 and 2, respectively and 2010 Station 2 was located at the mouth of Hither Creek (Figure 9). TN values at these stations were comparable to values at the historical stations (Table 5).

Long Pond TN levels appear to be relatively stable within the northern and southern reaches. In Long Pond, the historical value of TN at Station 2 was 0.971 $\pm$ 0.369 mg/L

while the 2012 [2010] level at comparable Town Station 5 was 1.031 [1.385] mg/L (Figure 9, Table 5). This station is within the mid to lower pond and the differences are not significant. Similarly, at historical Station 4, mean TN concentration was 0.894 ± 0.278 mg/L and the 2012 and 2010 values at Town 6 were 0.867 and 2.044 mg/L, respectively. The similarity in the 2012 and historical data provide important support that the 2010 results did not indicate a significant decline in the pond health. 2012 and to a lesser extent 2010 values are reasonable in comparison given the variability in the historical data as evidenced by the standard deviation (s.d.) of the means (Table 5).

In Hummock Pond, 3 Stations have both 2007 and 2010 and now 2012 data from Town sampling programs, Stations 1, 3 and 7 (see Figure 4). At Station 1, the 2007 TN mean value was 0.751 ± 0.374 mg/L while the 2012 and 2010 values were 0.666 and 0.616 mg/L (Table 6). For Station 3 (2007) the TN mean value was 0.630 ± 0.388 mg/L and the 2012 and 2010 means were 0.863 and 0.589 mg/L (Table 6). The Station 7 2007 mean for TN was 1.283 ± 0.969 mg/L while the 2012 and 2010 values were 1.301 and 1.786 mg/L (Table 6). Overall, both the 2012 and 2010 data in composite, yield TN levels comparable to the prior 2007 data and no improvement is indicated. These TN levels are very high for brackish water systems and indicative of nitrogen impaired resources either resulting from watershed inputs or insufficient tidal exchange (or both).

Town data for Miacomet Pond was available at all 3 Stations from 2005 and 2010 (see Figure 5). At Station 1, the 2005 mean TN concentration was 0.842 ± 0.191 mg/L and the 2012 and 2010 values were 0.828 and 0.854 mg/L (Table 6). The Station 2 historical mean TN value was 0.855 ± 0.213 mg/L while the 2012 and 2010 concentrations were 0.880 and 0.811 mg/L (Table 6). Finally at Station 3 the lone 2005 value of TN was 0.280 mg/L. Both the 2012 and 2010 TN levels were significantly higher, consistent with the other stations (1 & 2) at 0.950 and 1.093 mg/L, respectively (Table 6). It is not clear why the lone TN value in 2005 was so low compared with the other Stations in the Pond but both the 2012 and 2010 measurements and the historical data from the other 2 stations agree well.

**Trophic State of the Estuaries of Nantucket Island**

The Trophic State of an estuary is a quantitative indicator of its nutrient related ecological health and is based on concentrations of Nitrogen, Secchi Depth, lowest measured concentrations of Dissolved Oxygen (average of lowest 20% of measurements), and Chlorophyll pigments (surrogate for phytoplankton biomass). Trophic health scales generally range from Oligotrophic (healthy-low nutrient) to Mesotrophic (showing signs of deterioration of health due to nutrient enrichment) to Eutrophic (unhealthy, deteriorated condition, high nutrient). The Trophic Health Index Score used here is a basic numerical scale based on criteria for open water embayments and uses the above mentioned measured parameters to create a habitat quality scale (Howes et al. 1999, http://www.savebuzzardsbay.org). For the estuaries within the Town of Nantucket, a trophic index score was calculated for each sampling location using the 2010, 2012 and 2013 data. The Index scores were calculated in 2 ways, one which included the low dissolved oxygen for each year in the index ("with DO", Table 7) and one which excluded the oxygen metric ("without DO", Table 8). The reason for this dual approach is that in many estuaries, such as those on Nantucket, there are only periodic depletions in bottom water dissolved oxygen, generally related to meteorological events. While these short-term depletions have important ecological

consequences, they are difficult to capture in programs that sample 4 or 5 dates per summer. In these cases, inclusion of the oxygen tends to bias the Index upwards (i.e. higher quality) because of the greater probability of capturing high versus low oxygen events. This bias was found in the previous analysis of the 2010 dataset, as well as for other estuaries in s.e. Massachusetts. However, there was no substantive difference between the "with DO" and "without DO" Index scores based on the 2013 data, although the analysis is presented herein (Tables 7a and 8a). It should be noted that this bias relates only to the oxygen data, the other water quality parameters do not change as rapidly as dissolved oxygen and therefore the sampling program adequately captures accurate concentrations of nutrient related metrics (DO changes by the hour). For the sake of completeness, the Index scores are calculated in both ways, although the scores that exclude the oxygen data appear to more accurately represent the present level of estuarine health in some years (e.g. 2010) and are more consistent over the 3 years of monitoring with the Massachusetts Estuaries Project (MEP) assessments which include higher level measurements including long-term time series dissolved oxygen records (continuous measurements), which avoids the sampling bias issue.

The Health Status of each site was based on the Index Score, which is based on the data collected during the sampling events. The ranges of Index scores that fall within a particular Health Status determination are given at the bottom of both Tables 7 and 8 with the Index values and description for each monitoring station. Figures 10-14 show the distribution of Health Status throughout each estuary based on each of the 3 years of monitoring (2010, 2012 and 2013). Values calculated with the dissolved oxygen data are shown as upright triangles (left symbol of each pair) and values without the oxygen data are shown as inverted triangles (right symbol of each pair). The colors of each triangle represent the Bay Health Index status of its site and follow the designation scheme below:

| **Color** | **Health Status** |
|---|---|
| Blue | High Quality |
| Blue/Yellow | High-Moderate |
| Yellow | Moderate |
| Yellow/Red | Moderate/Fair |
| Red | Fair/Poor |

There were 8 stations among the 5 estuaries in 2012 and only 3 in 2013 that had differences in Trophic Index scores between including and excluding DO from the calculations. In 7 of the 8 cases in 2012 and only 1 of 3 in 2013 did excluding the minimum DO metric result in a lowering of the score. This is similar to what was found in 2010. It should be noted that the oxygen data from the monitoring program will support an index when a sufficient number of dates are collected over several years, as has been found in MEP analysis of Cape Cod estuaries. It appears that this will be the case for the 2014 analysis. The integrated water quality scores, as represented by the Index were generally consistent between all 3 years of monitoring. This is expected as nutrient related health does not typically change rapidly unless a significant alteration has occurred to the watershed nitrogen loading or to tidal flushing of a basin. However, 2 systems do appear to show a potential shift in nitrogen related health, Hither Creek and lower Hummock Pond (see below). Based upon the results it is possible to assess the nutrient related health of the basins within each of the 5 estuarine systems within the Nantucket Water Quality Monitoring Program. The following assessments rely mainly

on the "without DO" scores (right-hand triangles) as they most accurately represent current conditions:

**Madaket Harbor**

The water with the poorest “health” status is in Hither Creek at Station 1 (Table 7, 8, Figure 10). The 2010, 2012 and 2013 datasets indicate that this basin is clearly nitrogen enriched and showing continuing impairment. In contrast, the main basin of Madaket Harbor is showing relatively high water quality in 2010, 2012, and 2013 with a slight gradient on the ebbing tide from offshore of Hither Creek out to the Harbor entrance. The gradient was most significant in 2012 and 2013. It appears that Station 2, near the outlet to Hither Creek is receiving low quality waters on the ebb tide from Hither Creek and that this is controlling water quality at this nearshore location. The inter-annual difference at this site likely stems from the degree that the poor water quality plume from Hither Creek was captured each year, than a shift in status. In contrast, the offshore sites (3 & 4) support high quality waters resulting from low nitrogen inputs and very high rates of water exchange.

**Long Pond**

Long Pond operates semi-independently from Madaket Harbor, although waters are exchanged between them via Hither Creek and Madaket Ditch (Figure 10). Unlike Madaket Harbor which is marine, Long Pond is a brackish water system resulting from groundwater inflows and restricted tidal exchange. Long Pond Bay Health scores for both stations in the 3 years of monitoring (2010, 2012 and 2013) clearly indicate poor nutrient related water quality. It is nearly certain that this poor water quality water flowing into the head of Hither Creek during the ebb tide contributes to local inputs in creating the poor water quality in Hither Creek as well. While there may be some small decline in nitrogen levels in the upper basin (Station 6) the level is still very high and results in poor clarity, algal blooms and nutrient related stress to aquatic resources. The lack of change in the Health Index for Long Pond results in part from the relative coarseness of the Index, where sometimes large index score changes are required to change the Index value. The analysis of key metrics (Chlorophyll a, water clarity-Secchi and total nitrogen) individually show improving water quality at stations 5 and 6 in 2012 and 2013 compared to 2010 (see analysis and figures above). The issue is that presently there has not been a large enough shift to bring metrics above Health Index thresholds to change the rating significantly.

**Nantucket Harbor**

Nantucket Harbor is presently supporting the highest water quality of Nantucket's estuaries. Most of the main basin is supporting high quality waters, with only a small level of decline in uppermost basin of the main Harbor, Wauwinet basin, and a nearshore station at Children's Beach (Figure 11). Wauwinet basin had the highest average total nitrogen values for the Harbor System in 2013 (0.415) consistent with its designation as the sentinel station for the main basin. However, the enclosed sub-basin of Polpis Harbor (East and West) is showing moderate impairment and only moderate water quality. This designation stems both from both elevated nitrogen levels and consequent enhancement of phytoplankton, with summer averages of 10-15 ug/L typical. While the Harbor is generally supporting high quality waters, it is important that the decline in Wauwinet and Polpis be monitored and that efforts to restore these basins by the Town continue to move forward to meet the MassDEP TMDL for this system.

Overall, Nantucket Harbor appears to be relatively stable from year to year but is still above its TMDL threshold in the main basin and Polpis Harbor.

**Sesachacha Pond**

Sesachacha Pond is a closed coastal salt pond that has its water quality managed by periodically breaching the barrier beach to open the basin to tidal exchange with the adjacent Atlantic Ocean waters. This management action serves to flush out nutrients and organic matter on the ebb tides and receive saline waters on the flood tides. Sesachacha Pond was evaluated under the Massachusetts Estuaries Project and a nitrogen threshold (0.60 mg/L) was established for restoration of this system. Additionally, the MEP analysis recommended an additional mid-summertime opening as part of the pond management strategy to enhance flushing of the pond and improve water quality to reach the threshold. The water quality monitoring program in 2010, 2012 and 2013 is showing that the pond nitrogen levels are converging on the 0.60 mg/L total nitrogen threshold established by the MEP. Total nitrogen (TN) levels have dropped significantly from historical levels of 1.20 mg/L to ~0.68 mg/L in 2010 and 2012 and 0.67 mg/L in 2013, with associated improvements in the levels of water clarity and chlorophyll-*a*. The monitoring data suggest that the pond may still be reaching a new balance, as the limited 3 years of data (2010, 2012 and 2013) show virtually the same TN concentrations in each year. The evidence is growing that the water quality metrics pond-wide may have improved (Figure 12). Additional higher level assessment of Sesachacha Pond initiated by the 2010 monitoring results is being written to document the level of improvement in nutrient related health of this system and the degree to which the pond meets conditions for habitat restoration documented in the 2006 MEP nitrogen threshold analysis for Sesachacha Pond.

**Hummock Pond**

Hummock Pond is a closed coastal salt pond that is only periodically opened to the ocean to flush out nutrients and organic matter on the ebb tide and receive saline waters on the flood tide. Hummock Pond is opened at a sufficient frequency to sustain salinity levels in the 5-8 ppt range, with only small inter-annual differences (2012 slightly higher than 2010). The pond supports a small but clear salinity gradient from Station 1 nearest the ocean to Station 7 in the uppermost basin. The present non-tidal state and watershed nutrient inputs has resulted in moderate to poor nutrient related water quality throughout the pond, with poor water quality conditions the present norm (2005-2007, 2010, 2012, 2013). There is a small gradient in water quality with moderate to poor conditions near the ocean and poor conditions in the uppermost basins (Figure 13). This gradient stems from the periodic openings and over-wash events. The uppermost basin, Station 7, is approaching fresh/brackish conditions and is particularly eutrophic with phytoplankton blooms exceeding 70 ug/L (offshore waters are ~2 ug/L). This basin appears to have been artificially connected to the adjacent estuary and is the recipient of much of the freshwater inflow. It is one of the most highly eutrophic basins within the Town of Nantucket. Due to the restricted tidal exchange even the lower basin of Hummock Pond supports moderate to high average chlorophyll levels ~10 ug/L (2010, 2012). All of the metrics are consistent with a nutrient impaired basin in both 2010 and 2012. It should be noted that the lower third of the Hummock Pond Estuary is currently supporting impaired benthic animal habitat even though conditions are the "best" in the overall impaired system.

## Miacomet Pond

Miacomet Pond is a closed coastal salt pond that is seldom (once in the past ten years) opened to the ocean to flush out nutrients and organic matter on the ebb tide and receive saline waters on the flood tide. Salinity levels in each of the 3 years of monitoring has been <0.6 ppt indicate that the pond has not been opened to tidal flow for a significant period. The present non-tidal state and watershed nutrient inputs has resulted in a decline in nutrient related water quality throughout the pond, with poor water quality conditions the present norm (Figure 14). This can be seen, for example, in the high chlorophyll levels (2010: 12-50 ug/L); 2012: 10-20 ug/L; 2013: 20-26 ug/L) several times the levels found in the high quality basins of Nantucket and Madaket Harbors. All of the metrics are consistent with a nutrient impaired basin. However, if the freshening of this basin continues, it may come into a new equilibrium as a purely freshwater system and will need to be reassessed as such. However, it will be difficult for Miacomet Pond to maintain itself as a purely freshwater system as storm overwash and rising sea level will tend to periodically cause seawater intrusion into its lower basin. An analysis of future conditions for Miacomet Pond as sea level rises may be in order in the near future, as remediation is considered.

## Recommendations for Future Monitoring

Due to the critical importance of dissolved oxygen to the ecological health of an estuarine basin, additional data should be collected using high frequency automated sensors when the low frequency sampling of the monitoring program suggests that a problem may exist in a specific basin. At this point, Polpis Harbor, Madaket Harbor (station 2) and lower Miacomet Pond should be considered for this analysis at some time in the future. However, procedural steps should also be implemented to strengthen the oxygen data base from the on-going monitoring program.

Approaches to address these 2 issues are:

1) Deploying in situ oxygen meters (sondes) on the bottom of specific estuaries at several strategic locations for the summer months when periodic hypoxic or anoxic events in bottom waters can occur.

2) Long Pond is approaching the time when a detailed analysis of nitrogen entering from the land fill should be conducted, particularly how the land fill remediation is projected to improve water quality in the adjacent estuary. The monitoring results from 2012 and 2013 appear to show a significant reduction in TN over historical conditions and 2010.

**Table 2a.** Summary of Water Quality Parameters, 2013 Nantucket Sampling Program. Values are Station Averages of all sampling events, May-October for estuarine and harbor sites. .

| 2013 Station I.D. | Depth m | Secchi Depth m | Secchi Depth %WC | 20% Low DO mg/L | 20% Low DO %Sat | Salinity ppt | PO4 mg/L | NH4 mg/L | N0x mg/L | DIN mg/L | DON mg/L | PON mg/L | TON mg/L | TN mg/L | T-Pig ug/L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **HUM-1** | 2.6 | 1.0 | 0.4 | 5.86 | 63% | 0.9 | 0.029 | 0.030 | 0.018 | 0.047 | 0.554 | 0.169 | 0.722 | 0.769 | 8.2 |
| **HUM-3** | 2.4 | 1.0 | 0.4 | 5.20 | 56% | 0.8 | 0.034 | 0.075 | 0.016 | 0.091 | 0.571 | 0.165 | 0.736 | 0.827 | 7.2 |
| **HUM-5** | 2.2 | 0.6 | 0.3 | 4.20 | 45% | 0.5 | 0.073 | 0.063 | 0.026 | 0.088 | 0.575 | 0.217 | 0.793 | 0.881 | 8.3 |
| **HUM-7** | 3.5 | 0.6 | 0.2 | 4.08 | 44% | 0.5 | 0.061 | 0.077 | 0.012 | 0.089 | 0.408 | 0.674 | 1.081 | 1.170 | 16.9 |
| **HUM-8** | 2.2 | 0.6 | 0.3 | 3.32 | 36% | 0.4 | 0.079 | 0.042 | 0.018 | 0.061 | 0.672 | 0.331 | 1.004 | 1.064 | 7.9 |
| **LONG-5** | 1.1 | 0.7 | 0.7 | 5.87 | 75% | 11.9 | 0.009 | 0.015 | 0.008 | 0.022 | 0.358 | 0.328 | 0.686 | 0.709 | 8.1 |
| **LONG-6** | 1.0 | 0.7 | 0.7 | 3.82 | 49% | 12.7 | 0.005 | 0.017 | 0.008 | 0.025 | 0.561 | 0.294 | 0.855 | 0.880 | 9.9 |
| **MH1** | 2.2 | 1.7 | 0.8 | 4.36 | 61% | 25.7 | 0.019 | 0.047 | 0.019 | 0.065 | 0.374 | 0.134 | 0.508 | 0.573 | 4.2 |
| **MH2** | 1.9 | 1.8 | 1.0 | 5.25 | 74% | 30.6 | 0.012 | 0.021 | 0.004 | 0.025 | 0.215 | 0.083 | 0.298 | 0.323 | 1.8 |
| **MH3** | 2.0 | 2.0 | 1.0 | 5.25 | 74% | 31.0 | 0.011 | 0.014 | 0.005 | 0.019 | 0.209 | 0.087 | 0.295 | 0.314 | 2.2 |
| **MH4** | 4.5 | 3.0 | 0.7 | 5.82 | 82% | 31.3 | 0.013 | 0.015 | 0.007 | 0.023 | 0.194 | 0.062 | 0.256 | 0.278 | 1.7 |
| **MP1** | 1.9 | 1.0 | 0.6 | 5.46 | 66% | 0.2 | 0.009 | 0.015 | 0.006 | 0.020 | 0.481 | 0.290 | 0.771 | 0.792 | 19.5 |
| **MP2** | 3.1 | 1.2 | 0.4 | 4.22 | 51% | 0.3 | 0.014 | 0.029 | 0.022 | 0.051 | 0.429 | 0.555 | 0.985 | 1.036 | 20.2 |
| **MP3** | 1.6 | 0.9 | 0.6 | 5.20 | 63% | 0.1 | 0.049 | 0.036 | 0.104 | 0.143 | 0.378 | 0.540 | 0.917 | 1.058 | 26.2 |
| **NAN1** | 5.5 | 3.2 | 0.6 | 5.10 | 74% | 31.2 | 0.014 | 0.015 | 0.003 | 0.018 | 0.182 | 0.062 | 0.244 | 0.262 | 2.6 |
| **NAN2** | 6.0 | 2.9 | 0.5 | 4.80 | 70% | 31.1 | 0.014 | 0.019 | 0.006 | 0.024 | 0.231 | 0.090 | 0.321 | 0.345 | 3.7 |
| **NAN3** | 6.2 | 2.6 | 0.4 | 3.48 | 50% | 30.9 | 0.019 | 0.016 | 0.004 | 0.020 | 0.241 | 0.154 | 0.395 | 0.415 | 6.4 |
| **NAN4** | 4.9 | 3.1 | 0.6 | 5.66 | 82% | 31.3 | 0.016 | 0.017 | 0.004 | 0.021 | 0.226 | 0.070 | 0.295 | 0.317 | 2.9 |
| **NAN5** | 2.3 | 1.9 | 0.8 | 3.90 | 57% | 30.1 | 0.018 | 0.012 | 0.005 | 0.017 | 0.208 | 0.159 | 0.368 | 0.385 | 5.6 |
| **NAN6** | 2.7 | 2.0 | 0.8 | 3.26 | 47% | 30.5 | 0.016 | 0.023 | 0.004 | 0.026 | 0.221 | 0.153 | 0.374 | 0.401 | 5.9 |
| **NAN7** | 2.5 | 1.9 | 0.8 | 5.02 | 73% | 31.1 | 0.013 | 0.013 | 0.004 | 0.017 | 0.183 | 0.122 | 0.305 | 0.323 | 4.6 |
| **NAN8** | 3.2 | 2.1 | 0.9 | 4.96 | 72% | 31.1 | 0.013 | 0.028 | 0.004 | 0.032 | 0.189 | 0.084 | 0.272 | 0.304 | 2.9 |
| **SES 1** | 4.9 | 2.1 | 0.4 | 5.83 | 79% | 17.1 | 0.044 | 0.045 | 0.011 | 0.055 | 0.533 | 0.125 | 0.658 | 0.714 | 4.7 |
| **SES 2** | 4.3 | 2.4 | 0.6 | 5.2 | 71% | 17.0 | 0.043 | 0.025 | 0.008 | 0.034 | 0.477 | 0.110 | 0.587 | 0.621 | 4.1 |
| **SES 3** | 4.5 | 2.5 | 0.6 | 5.6 | 75% | 17.0 | 0.046 | 0.031 | 0.011 | 0.042 | 0.512 | 0.109 | 0.621 | 0.663 | 3.8 |
| **SES 4** | 3.9 | 2.6 | 0.7 | 5.6 | 76% | 17.0 | 0.040 | 0.034 | 0.013 | 0.046 | 0.518 | 0.111 | 0.630 | 0.677 | 3.8 |

**Table 2b.** Summary of Water Quality Parameters, 2012 Nantucket Sampling Program. Values are Station Averages of all sampling events, May-October for estuarine and harbor sites. Stream sites were sampled once in June (see Table 1b).

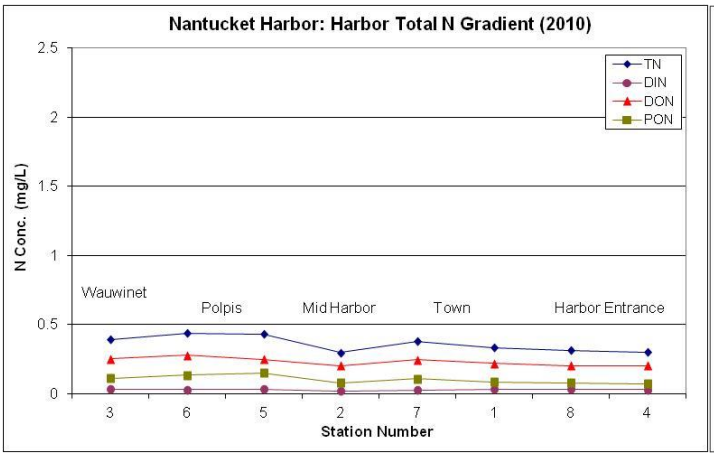
| Station I.D. | Secchi Depth m | Secchi Depth %WC | 20% Low DO mg/L | 20% Low DO %Sat | Salinity ppt | PO4 mg/L | NH4 mg/L | N0x mg/L | DIN mg/L | DON mg/L | PON mg/L | TON mg/L | TN mg/L | T-Pig ug/L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **HUM-1** | 1.0 | 44% | 6.27 | 79% | 7.6 | 0.020 | 0.044 | 0.006 | 0.050 | 0.439 | 0.178 | 0.616 | 0.666 | 8.7 |
| **HUM-3** | 1.2 | 58% | 6.20 | 79% | 7.0 | 0.029 | 0.039 | 0.003 | 0.042 | 0.573 | 0.249 | 0.822 | 0.863 | 8.3 |
| **HUM-5** | 0.8 | 44% | 6.56 | 82% | 6.3 | 0.030 | 0.043 | 0.004 | 0.047 | 0.540 | 0.283 | 0.824 | 0.871 | 12.7 |
| **HUM-7** | 0.7 | 21% | 5.76 | 70% | 4.8 | 0.011 | 0.085 | 0.031 | 0.117 | 0.546 | 0.638 | 1.184 | 1.301 | 27.2 |
| **HUM-8** | 0.6 | 53% | 6.51 | 81% | 6.0 | 0.030 | 0.054 | 0.005 | 0.058 | 0.534 | 0.352 | 0.885 | 0.944 | 17.5 |
| **LONG-5** | 0.6 | 58% | 5.49 | 71% | 16.8 | 0.067 | 0.063 | 0.007 | 0.069 | 0.441 | 0.503 | 0.944 | 1.013 | 18.3 |
| **LONG-6** | 0.5 | 51% | 5.13 | 67% | 18.6 | 0.027 | 0.049 | 0.008 | 0.057 | 0.437 | 0.373 | 0.810 | 0.867 | 7.7 |
| **MH1** | 1.7 | 70% | 6.88 | 98% | 26.8 | 0.026 | 0.115 | 0.015 | 0.131 | 0.332 | 0.192 | 0.525 | 0.655 | 9.6 |
| **MH2** | 2.3 | 100% | 8.16 | 115% | 30.9 | 0.015 | 0.078 | 0.010 | 0.088 | 0.272 | 0.084 | 0.356 | 0.444 | 1.8 |
| **MH3** | 2.4 | 100% | 7.55 | 104% | 31.6 | 0.018 | 0.063 | 0.011 | 0.074 | 0.217 | 0.065 | 0.282 | 0.356 | 1.8 |
| **MH4** | 3.7 | 90% | 8.35 | 119% | 31.6 | 0.019 | 0.032 | 0.009 | 0.041 | 0.189 | 0.068 | 0.257 | 0.297 | 2.0 |
| **MP1** | 1.5 | 97% | 7.14 | 79% | 0.3 | 0.007 | 0.057 | 0.004 | 0.061 | 0.546 | 0.221 | 0.767 | 0.828 | 10.8 |
| **MP2** | 1.5 | 67% | 7.24 | 80% | 0.4 | 0.005 | 0.070 | 0.012 | 0.082 | 0.509 | 0.290 | 0.799 | 0.880 | 20.3 |
| **MP3** | 1.0 | 81% | 7.64 | 92% | 0.1 | 0.045 | 0.109 | 0.011 | 0.120 | 0.381 | 0.450 | 0.830 | 0.950 | 18.3 |
| **NAN1** | 3.5 | 73% | 5.22 | 74% | 31.6 | 0.020 | 0.045 | 0.011 | 0.056 | 0.210 | 0.070 | 0.279 | 0.335 | 3.8 |
| **NAN2** | 2.9 | 62% | 5.91 | 85% | 31.6 | 0.022 | 0.057 | 0.009 | 0.066 | 0.213 | 0.091 | 0.304 | 0.364 | 3.7 |
| **NAN3** | 2.4 | 40% | 5.86 | 87% | 31.8 | 0.027 | 0.035 | 0.008 | 0.044 | 0.261 | 0.117 | 0.371 | 0.411 | 4.0 |
| **NAN4** | 2.9 | 63% | 6.29 | 90% | 31.6 | 0.017 | 0.031 | 0.007 | 0.038 | 0.212 | 0.094 | 0.306 | 0.344 | 3.6 |
| **NAN5** | 1.7 | 76% | 5.96 | 83% | 31.5 | 0.019 | 0.046 | 0.007 | 0.053 | 0.233 | 0.133 | 0.366 | 0.419 | 14.9 |
| **NAN6** | 2.1 | 76% | 5.50 | 77% | 31.5 | 0.019 | 0.042 | 0.006 | 0.048 | 0.289 | 0.147 | 0.436 | 0.484 | 6.3 |
| **NAN7** | 2.0 | 80% | 6.10 | 86% | 31.5 | 0.021 | 0.049 | 0.008 | 0.057 | 0.217 | 0.105 | 0.323 | 0.379 | 4.2 |
| **NAN8** | 1.9 | 100% | 5.20 | 74% | 31.5 | 0.017 | 0.050 | 0.006 | 0.057 | 0.225 | 0.090 | 0.315 | 0.371 | 3.6 |
| **SES 1** | 2.3 | 51% | 5.49 | 77% | 24.7 | 0.064 | 0.042 | 0.010 | 0.051 | 0.497 | 0.130 | 0.627 | 0.678 | 5.8 |
| **SES 2** | 2.5 | 52% | " | " | 24.7 | 0.065 | 0.087 | 0.014 | 0.101 | 0.405 | 0.120 | 0.525 | 0.627 | 5.1 |
| **SES 3** | 2.8 | 87% | " | " | 24.7 | 0.063 | 0.053 | 0.007 | 0.060 | 0.417 | 0.107 | 0.524 | 0.584 | 4.2 |
| **SES 4** | 2.7 | 77% | " | " | 24.8 | 0.062 | 0.060 | 0.010 | 0.070 | 0.456 | 0.142 | 0.599 | 0.668 | 4.5 |

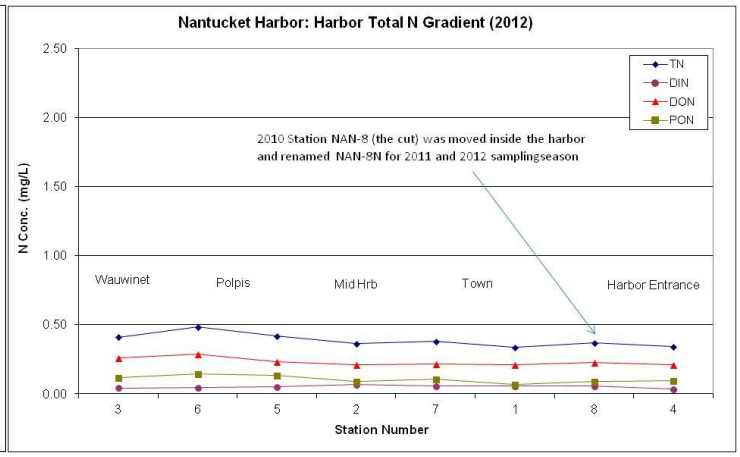
| Station ID | Secchi Depth (m) | Secchi Depth as % WC | 20% Low D.O. (mg/L) | 20% Low % Sat | Salinity ppt | PO4 mg/L | NH4 mg/L | NOX mg/L | DIN mg/L | DON mg/L | PON mg/L | TON mg/L | TN mg/L | Total Pig (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **HUM1** | 1.4 | 54.4% | 4.81 | 56.0% | 7.3 | 0.013 | 0.021 | 0.002 | 0.023 | 0.425 | 0.168 | 0.592 | 0.616 | 12.30 |
| **HUM3** | 1.3 | 61.5% | 4.99 | 59.8% | 6.4 | 0.012 | 0.022 | 0.003 | 0.025 | 0.380 | 0.184 | 0.564 | 0.589 | 11.04 |
| **HUM5** | 0.9 | 44.2% | 4.65 | 56.1% | 5.3 | 0.015 | 0.020 | 0.003 | 0.023 | 0.430 | 0.313 | 0.743 | 0.766 | 27.03 |
| **HUM7** | 0.9 | 23.4% | 3.89 | 45.0% | 4.0 | 0.284 | 0.070 | 0.069 | 0.139 | 0.628 | 1.020 | 1.647 | 1.786 | 67.66 |
| **HUM8** | 0.7 | 51.0% | 4.80 | 56.5% | 4.4 | 0.025 | 0.031 | 0.008 | 0.039 | 0.584 | 0.360 | 0.944 | 0.983 | 33.02 |
| **LONG5** | 0.6 | 48.5% | 4.77 | 62.9% | 16.0 | 0.071 | 0.009 | 0.002 | 0.011 | 0.480 | 0.894 | 1.374 | 1.385 | 18.08 |
| **LONG6** | 0.6 | 48.8% | 4.76 | 62.9% | 15.9 | 0.028 | 0.022 | 0.003 | 0.026 | 0.567 | 1.452 | 2.019 | 2.044 | 24.21 |
| **MH1** | 1.6 | 67.1% | 3.00 | 40.1% | 26.8 | 0.024 | 0.045 | 0.005 | 0.050 | 0.316 | 0.260 | 0.576 | 0.626 | 14.20 |
| **MH2** | 1.9 | 93.9% | 3.52 | 47.9% | 29.7 | 0.014 | 0.024 | 0.003 | 0.027 | 0.264 | 0.145 | 0.409 | 0.436 | 9.37 |
| **MH3** | 2.3 | 100.0% | 4.39 | 55.5% | 30.8 | 0.011 | 0.024 | 0.002 | 0.026 | 0.213 | 0.084 | 0.297 | 0.324 | 6.14 |
| **MH4** | 3.8 | 58.3% | 4.27 | 55.6% | 31.1 | 0.015 | 0.024 | 0.002 | 0.026 | 0.190 | 0.069 | 0.259 | 0.285 | 4.21 |
| **MP1** | 1.5 | 86.3% | 5.43 | 54.0% | 0.7 | 0.003 | 0.030 | 0.002 | 0.032 | 0.557 | 0.265 | 0.822 | 0.854 | 16.29 |
| **MP2** | 1.9 | 58.5% | 5.70 | 62.8% | 0.6 | 0.002 | 0.044 | 0.002 | 0.046 | 0.554 | 0.210 | 0.764 | 0.811 | 11.50 |
| **MP3** | 1.3 | 83.1% | 4.93 | 56.6% | 0.1 | 0.031 | 0.048 | 0.056 | 0.104 | 0.499 | 0.490 | 0.990 | 1.093 | 51.52 |
| **NAN1** | 4.5 | 84.8% | 3.57 | 48.2% | 31.0 | 0.016 | 0.027 | 0.003 | 0.030 | 0.218 | 0.084 | 0.302 | 0.332 | 4.00 |
| **NAN2** | 3.4 | 62.8% | 3.45 | 47.4% | 31.0 | 0.018 | 0.016 | 0.003 | 0.019 | 0.201 | 0.077 | 0.278 | 0.297 | 5.36 |
| **NAN3** | 2.8 | 49.2% | 3.72 | 52.4% | 30.9 | 0.022 | 0.027 | 0.003 | 0.030 | 0.251 | 0.111 | 0.362 | 0.392 | 7.58 |
| **NAN4** | 3.7 | 84.5% | 3.89 | 52.2% | 29.8 | 0.015 | 0.027 | 0.002 | 0.029 | 0.203 | 0.070 | 0.273 | 0.283 | 4.15 |
| **NAN5** | 2.0 | 98.0% | 3.18 | 44.3% | 30.4 | 0.017 | 0.027 | 0.007 | 0.034 | 0.248 | 0.149 | 0.397 | 0.431 | 11.31 |
| **NAN6** | 2.2 | 88.7% | 3.26 | 45.7% | 30.5 | 0.016 | 0.024 | 0.004 | 0.028 | 0.277 | 0.133 | 0.410 | 0.438 | 10.31 |
| **NAN7** | 2.1 | 92.5% | 3.60 | 49.8% | 30.9 | 0.016 | 0.023 | 0.003 | 0.026 | 0.244 | 0.106 | 0.351 | 0.377 | 7.35 |
| **NAN8** | 2.4 | 100.8% | 3.65 | 50.0% | 31.1 | 0.018 | 0.031 | 0.002 | 0.033 | 0.204 | 0.076 | 0.280 | 0.313 | 3.93 |
| **SESA1** | 1.6 | 32.9% | 4.82 | 56.4% | 11.9 | 0.051 | 0.018 | 0.003 | 0.021 | 0.441 | 0.222 | 0.663 | 0.684 | 8.00 |
| **SESA2** | 1.4 | 28.6% | 4.83 | 56.4% | 11.9 | 0.045 | 0.024 | 0.003 | 0.027 | 0.469 | 0.219 | 0.688 | 0.715 | 7.19 |
| **SESA3** | 1.5 | 36.6% | 4.83 | 56.2% | 11.9 | 0.049 | 0.021 | 0.006 | 0.028 | 0.449 | 0.223 | 0.672 | 0.700 | 7.61 |
| **SESA4** | 1.5 | 38.7% | 4.83 | 56.4% | 11.9 | 0.046 | 0.024 | 0.003 | 0.027 | 0.470 | 0.221 | 0.691 | 0.718 | 6.73 |
| **82 WAUWINET** | ND | ND | ND | ND | 18.2 | 0.071 | 0.122 | 0.004 | 0.126 | 0.611 | 0.108 | 0.719 | 0.845 | 40.70 |
| **STREAM1** | ND | ND | ND | ND | 0.3 | 0.077 | 0.081 | 0.021 | 0.102 | 1.419 | 0.258 | 1.677 | 1.779 | 2.64 |
| **STREAM4** | ND | ND | ND | ND | <0.1 | 0.163 | 0.039 | 0.008 | 0.048 | 1.092 | 0.061 | 1.153 | 1.200 | 1.18 |
| **STREAM6B** | ND | ND | ND | ND | <0.1 | 0.006 | 0.059 | 0.004 | 0.064 | 1.701 | 0.374 | 2.076 | 2.139 | 16.37 |
| **STREAM6C** | ND | ND | ND | ND | <0.1 | 0.132 | 0.097 | 0.003 | 0.100 | 0.375 | 0.156 | 0.532 | 0.632 | 7.41 |
| **STREAM8** | ND | ND | ND | ND | 3.3 | 0.015 | 0.045 | 0.005 | 0.050 | 0.398 | 0.118 | 0.516 | 0.565 | 5.29 |

Secchi as % of WC is the % of the water column above the secchi depth, values of 100% means that the Secchi was at or below the bottom.
Lowest 20% of D.O. records for a site over the project period.

HUM = Hummock Pond, Long = Long Pond, MH = Madaket Harbor, MP = Miacomet Pond, NAN = Nantucket Harbor, SESA = Sesachacha Pond

**Table 2c.** Summary of Water Quality Parameters, 2010 Nantucket Sampling Program. Values are Station Averages of all sampling events, May-October for estuarine and harbor sites. Stream sites were sampled once in June (see Table 1a).



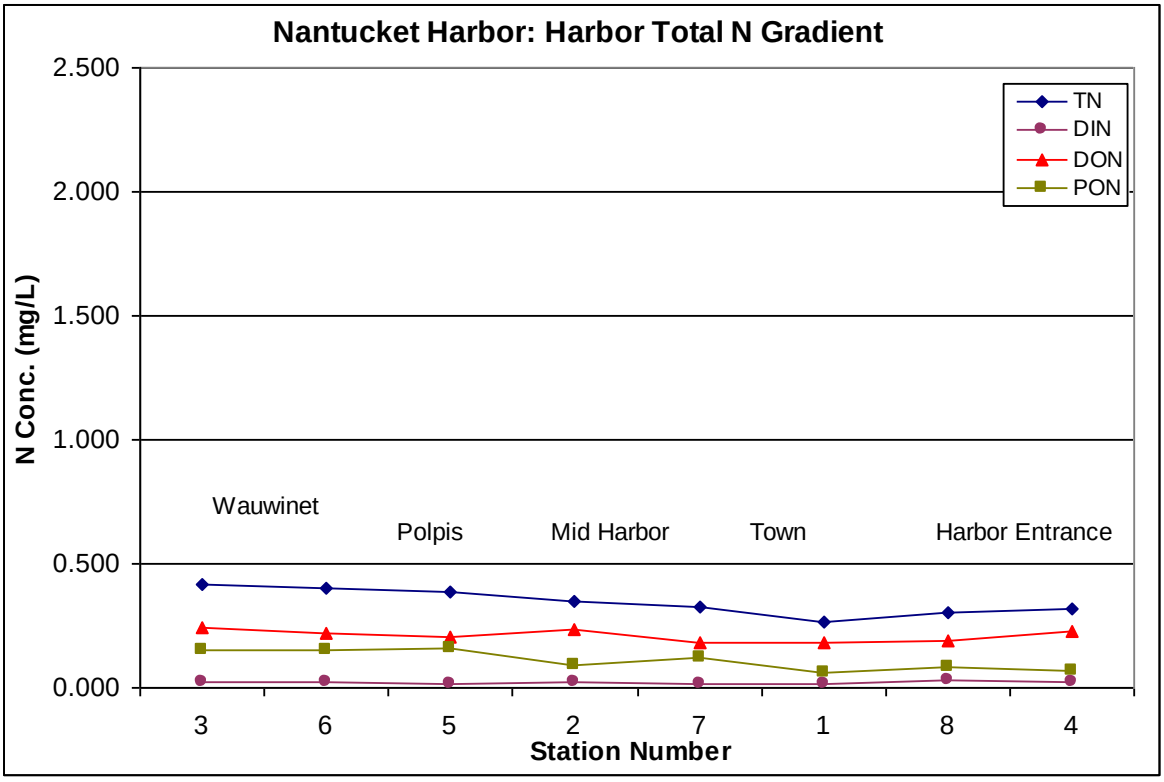
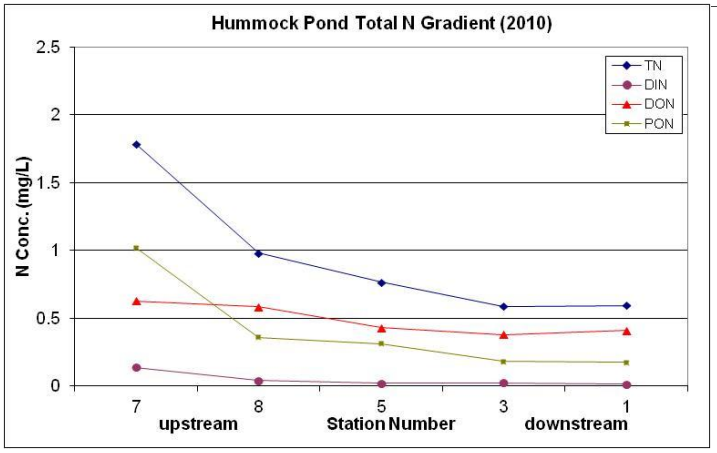
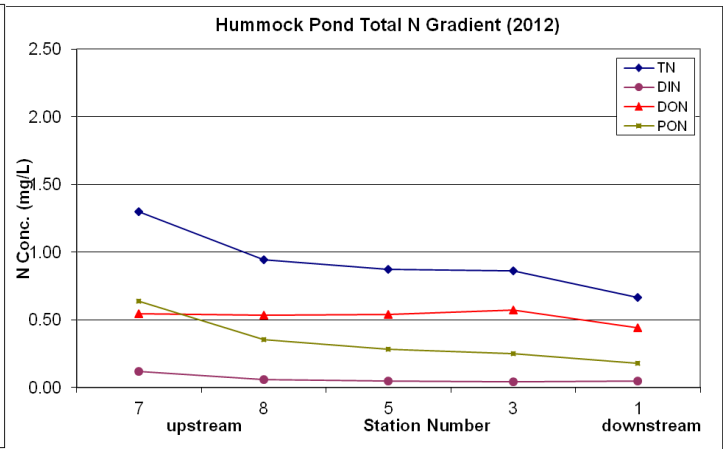
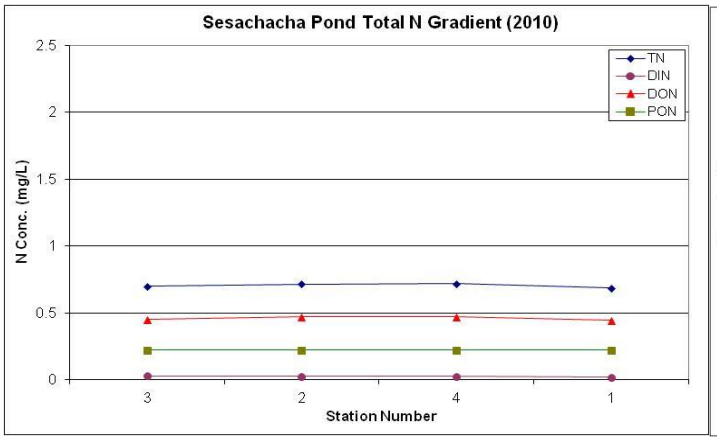
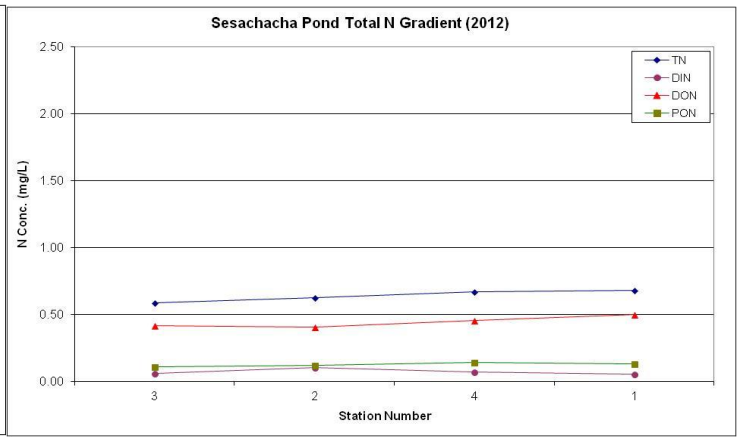




**Figure 6**. Comparison of nitrogen species (mg/L) in Nantucket Harbor in summers, 2010 (upper left); 2012 (upper right); 2013 (btm). Total nitrogen is the sum of the inorganic and organic fractions (top line in each graph). All figures are to same scale.



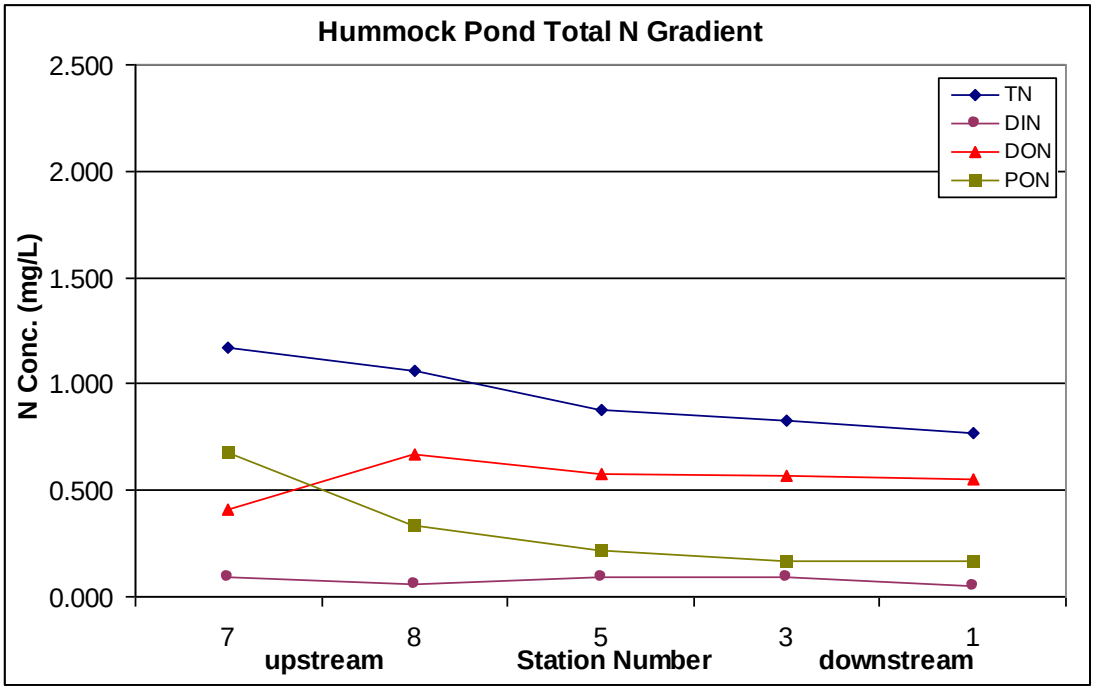
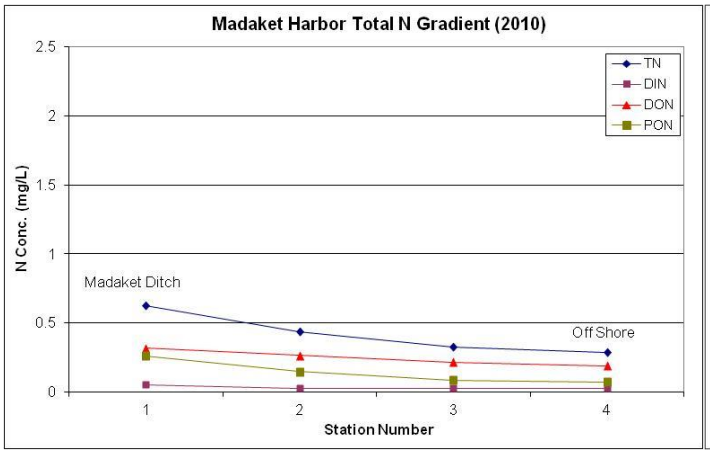
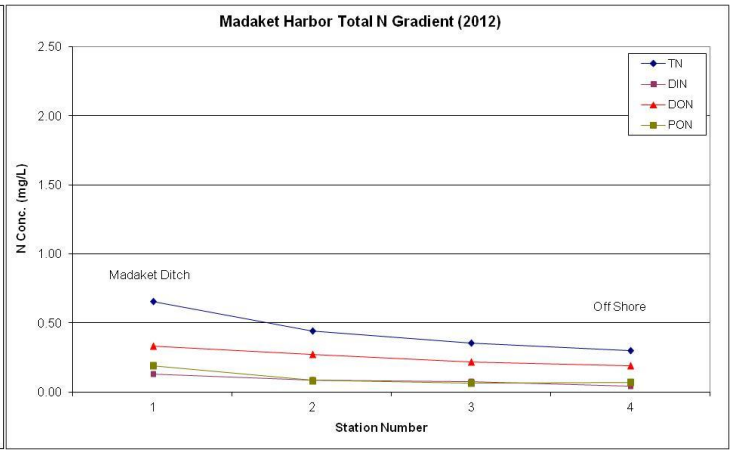




**Figure 6 cont'd**. Comparison of nitrogen species (mg/L) in Hummock Pond in summers, 2010 (upper left); 2012 (upper right); 2013 (btm). Total nitrogen is the sum of the inorganic and organic fractions (top line in each graph). All figures are to same scale.



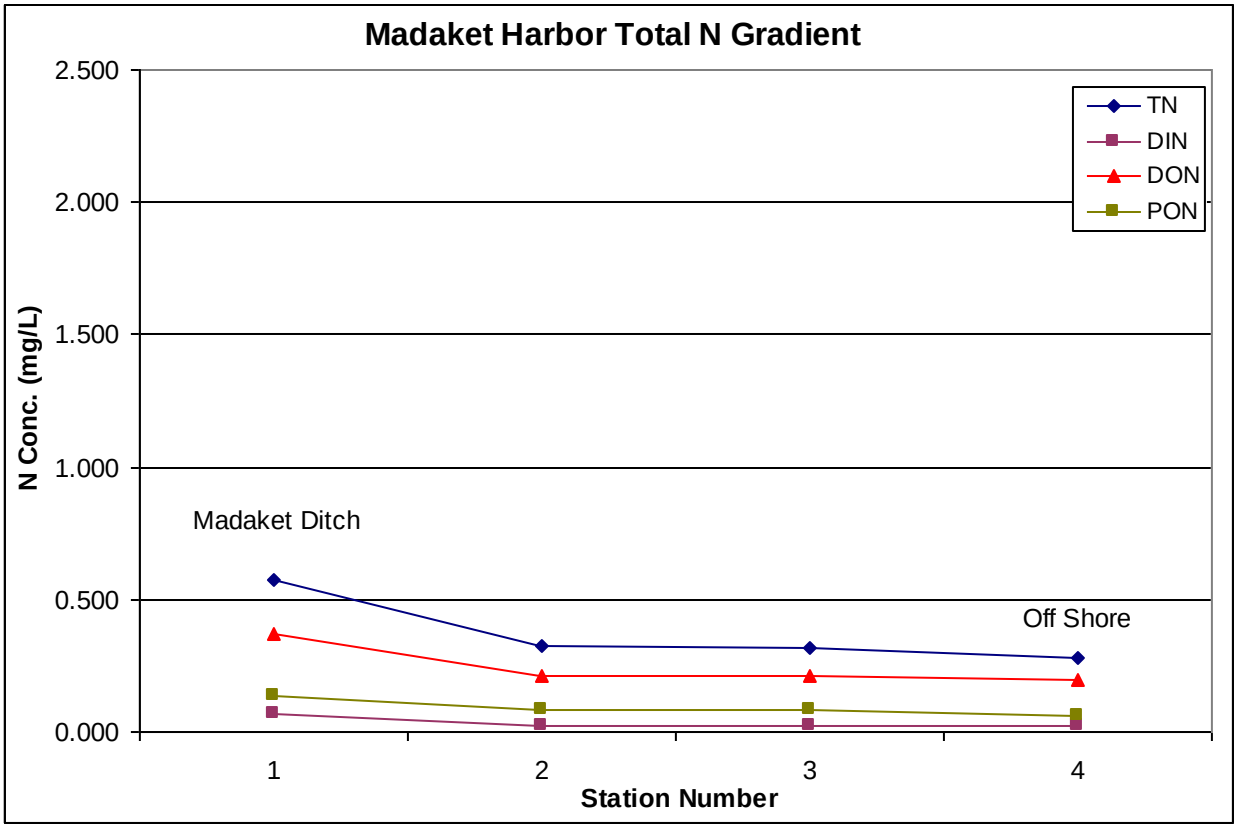
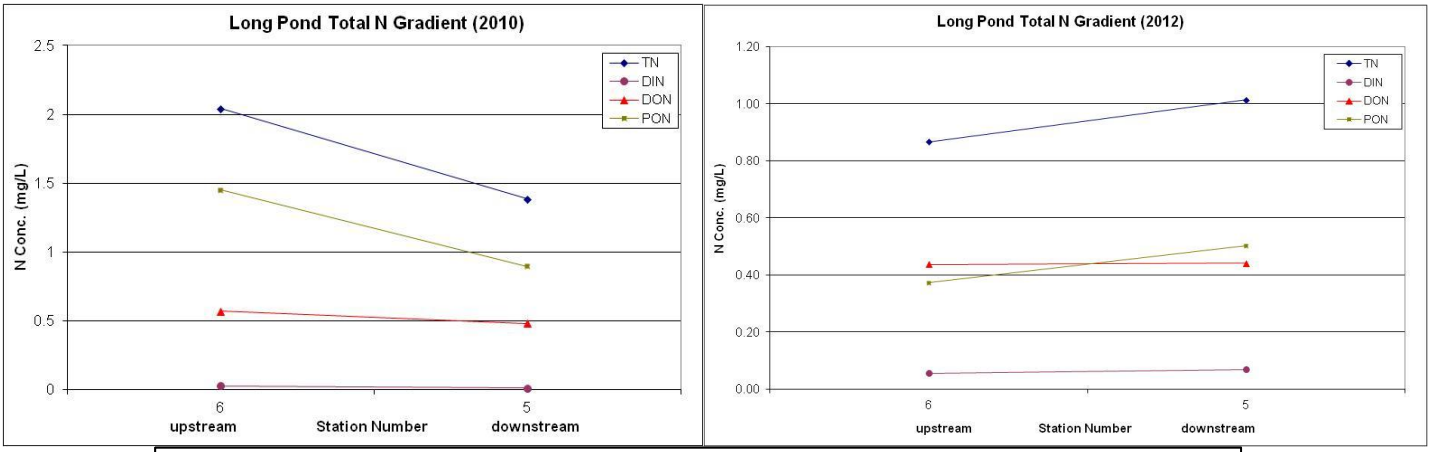




**Figure 6 cont'd**. Comparison of nitrogen species (mg/L) in Madaket Harbor in summers, 2010 (upper left); 2012 (upper right); 2013 (btm). Total nitrogen is the sum of the inorganic and organic fractions (top line in each graph). All figures are to same scale.



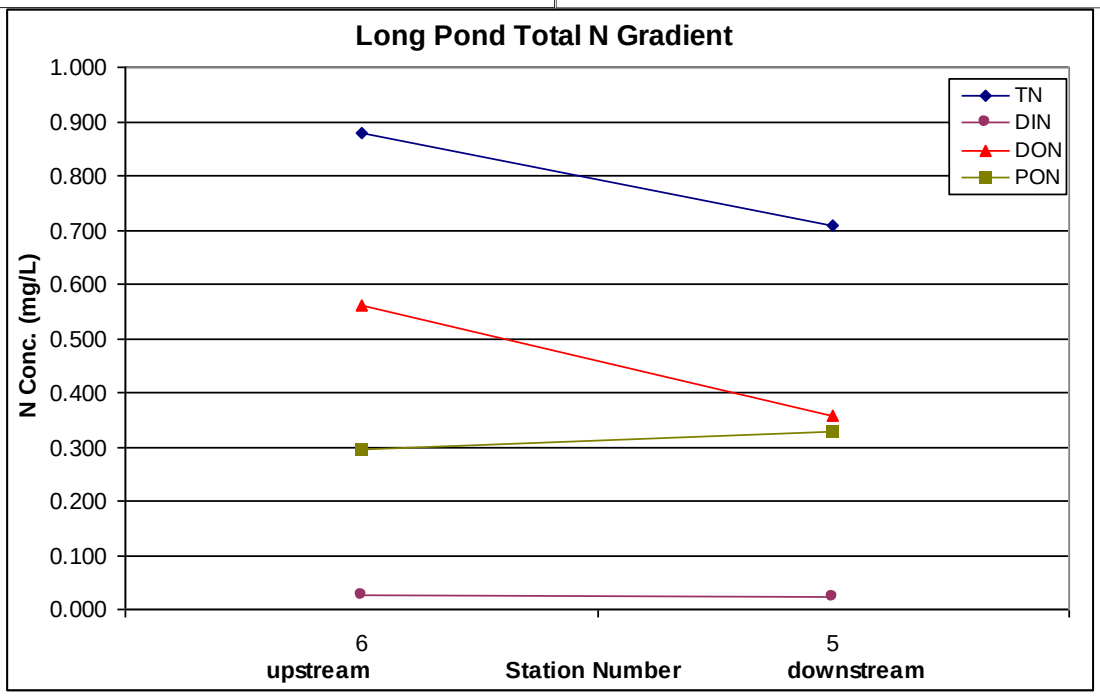




**Figure 6 cont'd**. Comparison of nitrogen species (mg/L) in Long Pond (Madaket Harbor System) in summers, 2010 (upper left); 2012 (upper right); 2013 (btm). Total nitrogen is the sum of the inorganic and organic fractions (top line in each graph). All figures are to same scale.

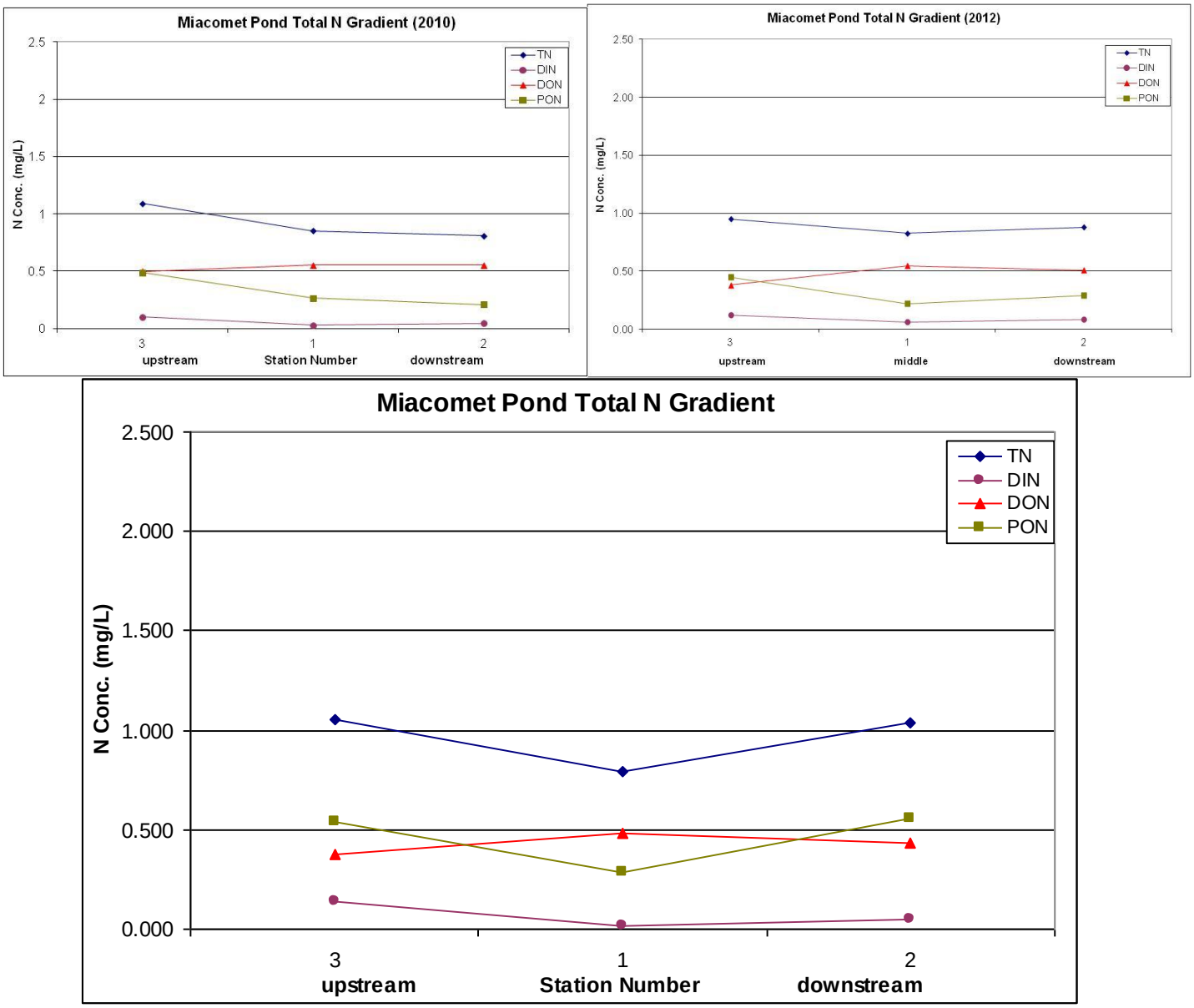



**Figure 6 cont'd**. Comparison of nitrogen species (mg/L) in Miacomet in summers, 2010 (upper left); 2012 (upper right); 2013 (btm). Total nitrogen is the sum of the inorganic and organic fractions (top line in each graph). All figures are to same scale.

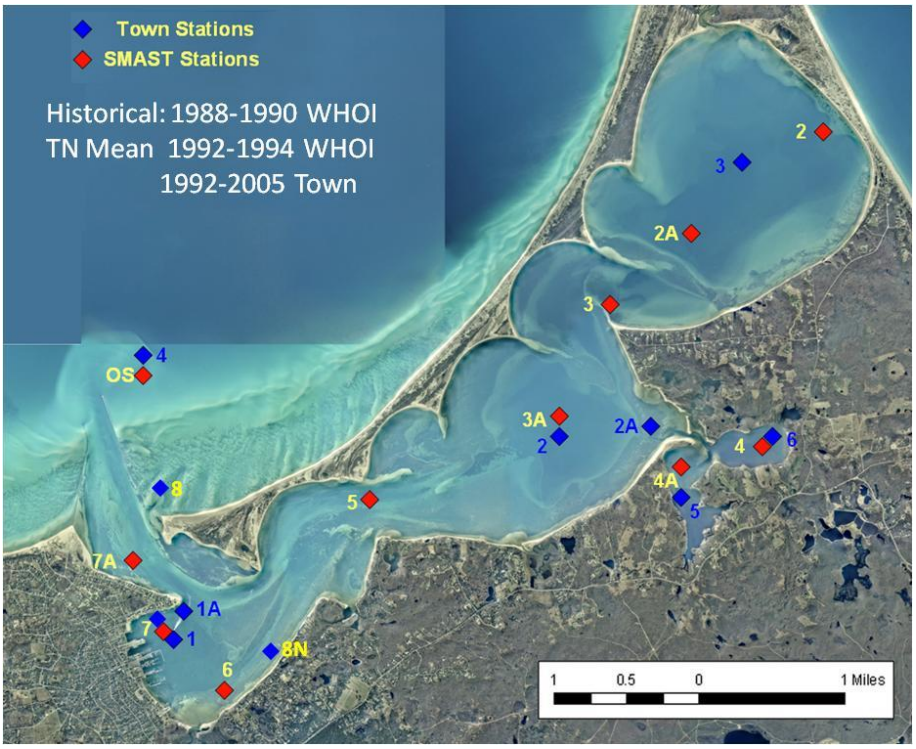



**Figure 7.** Estuarine water quality monitoring station locations in the Nantucket Harbor estuary system. Station labels correspond to those provided in Table 3 below. Red diamonds indicate locations of MEP monitoring stations. Blue diamonds are locations of Town sampling. Station 8 sampled in 2010, station 8N sampled in 2011 and 2012.

| Sub-Embayment | Monitoring Station | Historical MEP Mean TN (mg/L) | s.d. | 2010 Town ID | 2010 Mean TN (mg/L) | 2012 Mean TN (mg/L) | 2013 Mean TN (mg/L) |
|---|---|---|---|---|---|---|---|
| Head of the Harbor - Upper | 2 | 0.408 | 0.188 | NA | NS | NS | NS |
| Head of the Harbor - Mid | Town 3 | 0.401 | 0.115 | 3 | 0.392 | 0.411 | 0.415 |
| Head of the Harbor - Lower | 2A | 0.339 | 0.070 | NA | NS | NS | NS |
| Pocomo Head | 3 | 0.335 | 0.081 | NA | NS | NS | NS |
| Quaise Basin | 3A+Town 2 | 0.336 | 0.112 | 2 | 0.297 | 0.364 | 0.345 |
| East Polpis Harbor | 4+Town 6 | 0.362 | 0.105 | 6 | 0.438 | 0.484 | 0.401 |
| West Polpis Harbor | 4A+Town 5 | 0.388 | 0.119 | 5 | 0.431 | 0.419 | 0.385 |
| Abrams Point | 5 | 0.335 | 0.060 | NA | NS | NS | NS |
| Monomoy | 6 | 0.297 | 0.086 | NA | NS | NS | NS |
| Mooring Area | 7+Town 1, 1A | 0.326 | 0.106 | 1, 7 | 0.332, 0.377 | 0.335, 0.379 | 0.323 0.323 |
| Nantucket Sound | OS+Town 4 | 0.239 | 0.041 | 4 | 0.283 | 0.344[1] | 0.317[1] |

**Table 3.** Comparison of MEP mean TN with Town data (values mg/L) from Nantucket Harbor. MEP data collected in the summers of 1988 - 1990 and 1992 - 1994 by the Woods Hole Oceanographic Institution, and between 1992 and 2005 by the Town of Nantucket Marine Department and by the Nantucket Marine and Coastal Resources Department in summers 2010, 2012 & 2013.

[1] It is almost certain that this does not represent the TN level in the inflow to Nantucket Harbor on the flood tide, but rather the 2012 data is influenced by mixing with TN enriched outflowing waters. An attempt to control for this issue will be implemented in the 2013 monitoring program.

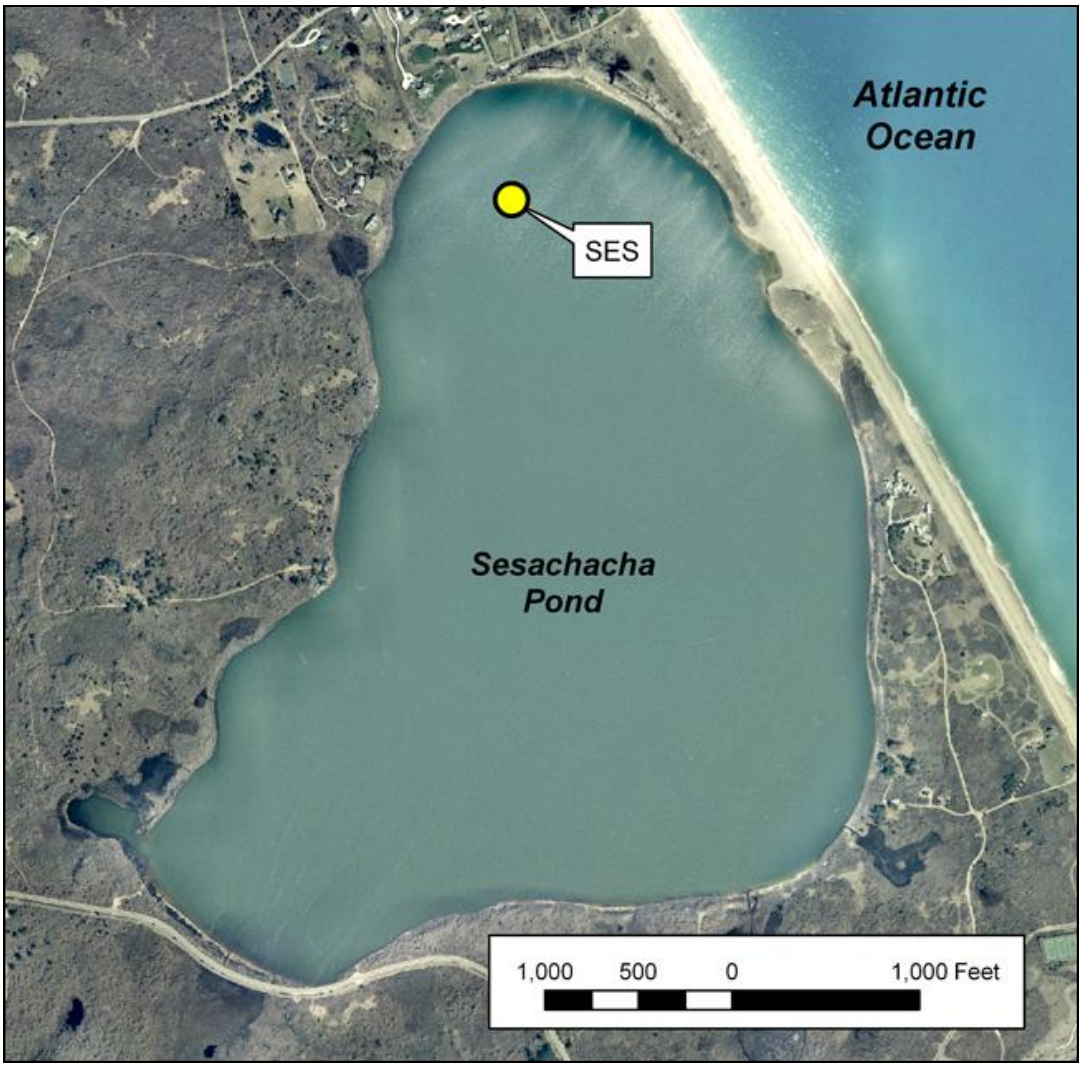



**Figure 8.** 2005 aerial photo showing MEP monitoring station location in Sesachacha Pond that was used in the water quality analysis for the Massachusetts Estuaries Project. Station SES corresponds to SESA-1 in Tables 2a,b and Station 1 in Figure 3.

| Sampling Station Location | Historical MEP Mean TN (mg/L) | s.d. | 2010 Mean TN (mg/L) | 2012 Mean TN (mg/L) | 2013 Mean TN (mg/L) |
|---|---|---|---|---|---|
| Sesachacha Pond | 1.197 | 0.078 | 0.684 (0.704) | 0.678 (0.639) | 0.714 (0.669) |

**Table 4.** Comparison of MEP mean values of TN with Town TN data (all values are mg/L) from Sesachacha Pond. MEP data were collected in the summers of 1992 through 2005. Town data were collected in the summers of 2010, 2012 and 2013 by the Town of Nantucket Marine and Coastal Resources Department. Values in 2010, 2012 & 2013 represent the average at Station 1, with the average of stations 1-4 in ( ).


**Figure 9.** Estuarine water quality monitoring station locations in the Madaket Harbor and Long Pond Systems.

| Sub-Embayment | Monitoring Station | Historical MEP Mean TN (mg/L) | s.d. | 2010 Mean TN (mg/L) | 2012 Mean TN (mg/L) | 2013 Mean TN (mg/L) |
|---|---|---|---|---|---|---|
| Madaket Harbor | MEP M1 | 0.336 | 0.098 | | | |
| Madaket Harbor | Town 4 | | | 0.285 | 0.297 | 0.278 |
| Madaket Harbor | MEP M2 | 0.395 | 0.083 | | | |
| Madaket Harbor | Town 2 | | | 0.436 | 0.444 | 0.323 |
| Madaket Harbor | MEP M3 | 0.415 | 0.090 | | | |
| Madaket Harbor | Town 3 | | | 0.324 | .356 | 0.314 |
| Hither Creek | MEP M4 | 0.581 | 0.193 | | | |
| Hither Creek | MEP M5 | 0.780 | 0.178 | | | |
| Madaket Harbor | MEP M6 | 0.347 | 0.067 | | | |
| Madaket Harbor | MEP M10 | 0.422 | 0.127 | | | |
| Hither Creek | MEP M11+Town 1 | 0.620 | 0.215 | 0.626 | 0.655 | 0.573 |
| Long Pond | MEP LOPO1 | 1.058 | 0.404 | | | |
| Long Pond | MEP LOPO2+Town 5 | 0.971 | 0.369 | 1.385 | 1.013 | 0.709 |
| Long Pond | MEP LOPO3 | 0.924 | 0.234 | | | |
| Long Pond | MEP LOPO4+Town 6 | 0.894 | 0.278 | 2.044 | 0.867 | 0.880 |
| North Head Long P. | MEP LOPO5 | 0.954 | 0.271 | | | |

**Table 5.** Comparison of MEP mean values of TN with Town TN data (all values are mg/L) from Madaket Harbor and Long Pond. MEP data were collected by SMAST in the summers of 2002 through 2004. Town data were collected in the summers of 2010, 2012 and 2013 by the Town of Nantucket Marine and Coastal Resources Department.

| Hummock Pond and Miacomet Pond Station ID's | 2013 TN (mg/L) Mean | 2012 TN (mg/L) Mean | 2010 TN (mg/L) Mean | 2005/2007 TN (mg/L) Mean | 2005/2007 TN (mg/L) S.D. |
|---|---|---|---|---|---|
| HUM1 | 0.769 | 0.666 | 0.616 | 0.751** | 0.374 |
| HUM3 | 0.827 | 0.863 | 0.589 | 0.630** | 0.388 |
| HUM5 | 0.881 | 0.871 | 0.766 | ND | ND |
| HUM7 | 1.170 | 1.301 | 1.786 | 1.283** | 0.969 |
| HUM8 | 1.064 | 0.944 | 0.983 | ND | ND |
| MP1 | 0.792 | 0.828 | 0.854 | 0.842* | 0.191 |
| MP2 | 1.036 | 0.880 | 0.811 | 0.855* | 0.213 |
| MP3 | 1.058 | 0.950 | 1.093 | 0.280* | 0 |
| | ***2005 data only** ****2007 data only** | | | | |

**Table 6.** Comparison of TN concentrations collected in 2005 (Miacomet Pond) and 2007 (Hummock Pond) by Nantucket Marine and Coastal Resources Department with Town TN data collected at both sites the summer of 2010 and 2012. All values are mg/L.

| Sta ID | Secchi SCORE | Low20% Oxsat SCORE | DIN SCORE | TON SCORE | T-Pig SCORE | 2013 EUTRO Index | Health Status |
|---|---|---|---|---|---|---|---|
| **HUM-1** | 29.6 | 56.8 | 47.1 | 0.0 | 16.9 | 30.1 | Fair-Poor |
| **HUM-3** | 30.2 | 42.1 | 18.9 | 0.0 | 26.8 | 23.6 | Fair-Poor |
| **HUM-5** | 0.0 | 15.8 | 20.1 | 0.0 | 15.8 | 10.3 | Fair-Poor |
| **HUM-7** | 0.8 | 12.2 | 19.8 | 0.0 | 0.0 | 6.6 | Fair-Poor |
| **HUM-8** | 0.0 | 0.0 | 36.3 | 0.0 | 20.1 | 11.3 | Fair-Poor |
| **LONG-5** | 11.2 | 77.9 | 81.0 | 0.0 | 17.3 | 37.5 | Moderate-Fair |
| **LONG-6** | 9.3 | 25.0 | 74.8 | 0.0 | 1.1 | 22.0 | Fair-Poor |
| **MH1** | 64.5 | 52.5 | 33.4 | 22.0 | 71.2 | 48.7 | Moderate |
| **MH2** | 69.3 | 75.4 | 75.1 | 91.8 | 100.0 | 82.3 | High |
| **MH3** | 73.6 | 75.4 | 86.5 | 93.0 | 100.0 | 85.7 | High |
| **MH4** | 99.0 | 88.1 | 79.3 | 100.0 | 100.0 | 93.3 | High |
| **MP1** | 31.0 | 62.2 | 83.7 | 0.0 | 0.0 | 35.4 | Moderate-Fair |
| **MP2** | 41.9 | 30.5 | 44.1 | 0.0 | 0.0 | 23.3 | Fair-Poor |
| **MP3** | 27.3 | 56.2 | 0.0 | 0.0 | 0.0 | 16.7 | Fair-Poor |
| **NAN1** | 100.0 | 75.7 | 88.4 | 100.0 | 100.0 | 92.8 | High |
| **NAN2** | 97.3 | 68.2 | 75.7 | 82.0 | 83.1 | 81.3 | High |
| **NAN3** | 89.9 | 28.4 | 84.1 | 54.8 | 36.9 | 58.8 | Moderate |
| **NAN4** | 100.0 | 88.6 | 81.4 | 93.1 | 100.0 | 92.6 | High |
| **NAN5** | 70.7 | 42.6 | 91.3 | 64.3 | 48.0 | 63.4 | High-Moderate |
| **NAN6** | 76.1 | 20.5 | 72.4 | 61.9 | 44.2 | 55.0 | Moderate |
| **NAN7** | 70.0 | 73.8 | 90.9 | 88.6 | 64.4 | 77.5 | High |
| **NAN8** | 78.6 | 72.3 | 64.2 | 100.0 | 100.0 | 83.0 | High |
| **SES 1** | 78.9 | 83.6 | 40.3 | 0.0 | 62.4 | 53.0 | Moderate |
| **SES 2** | 86.4 | 70.2 | 61.6 | 2.8 | 73.5 | 58.9 | Moderate |
| **SES 3** | 88.0 | 77.5 | 52.5 | 0.0 | 80.7 | 59.7 | Moderate |
| **SES 4** | 92.1 | 79.3 | 47.9 | 0.0 | 79.9 | 59.8 | Moderate |

**Table 7a.** 2013 Trophic Health Index Scores and status for water quality monitoring stations in Nantucket estuaries based upon open water embayment (not salt marsh) habitat quality scales. Index calculated *with* Dissolved Oxygen data (described in Howes et. al., 1999 at www.savebuzzardsbay.org).

| Station ID | Year | Secchi SCORE | Low20% Oxsat SCORE | DIN SCORE | TON SCORE | T-Pig SCORE | EUTRO Index | Health Status |
|---|---|---|---|---|---|---|---|---|
| **HUM-1** | 2012 | 30.8 | 84.2 | 45.0 | 0.0 | 12.0 | 34.4 | Moderate-Fair |
| **HUM-3** | 2012 | 41.0 | 83.4 | 52.8 | 0.0 | 16.0 | 38.6 | Moderate-Fair |
| **HUM-5** | 2012 | 17.5 | 89.3 | 47.3 | 0.0 | 0.0 | 30.8 | Fair-Poor |
| **HUM-7** | 2012 | 11.3 | 69.5 | 7.9 | 0.0 | 0.0 | 17.7 | Fair-Poor |
| **HUM-8** | 2012 | 1.0 | 87.1 | 38.0 | 0.0 | 0.0 | 25.2 | Fair-Poor |
| **LONG-5** | 2012 | 0.0 | 70.9 | 30.4 | 0.0 | 0.0 | 20.3 | Fair-Poor |
| **LONG-6** | 2012 | 0.0 | 64.1 | 39.3 | 0.0 | 21.9 | 25.1 | Fair-Poor |
| **MH1** | 2012 | 65.3 | 100.0 | 3.0 | 17.6 | 3.1 | 37.8 | Moderate-Fair |
| **MH2** | 2012 | 83.2 | 100.0 | 20.1 | 68.4 | 100.0 | 74.3 | High |
| **MH3** | 2012 | 84.8 | 100.0 | 27.7 | 99.0 | 100.0 | 82.3 | High |
| **MH4** | 2012 | 100.0 | 100.0 | 53.8 | 100.0 | 100.0 | 90.8 | High |
| **MP1** | 2012 | 55.3 | 84.6 | 36.2 | 0.0 | 0.0 | 35.2 | Moderate-Fair |
| **MP2** | 2012 | 55.4 | 85.3 | 23.2 | 0.0 | 0.0 | 32.8 | Moderate-Fair |
| **MP3** | 2012 | 31.0 | 100.0 | 6.7 | 0.0 | 0.0 | 27.5 | Fair-Poor |
| **NAN1** | 2012 | 100.0 | 76.4 | 40.2 | 100.0 | 79.4 | 79.2 | High |
| **NAN2** | 2012 | 98.9 | 92.6 | 32.5 | 89.4 | 83.0 | 79.3 | High |
| **NAN3** | 2012 | 85.2 | 96.0 | 50.7 | 63.0 | 76.7 | 74.3 | High |
| **NAN4** | 2012 | 98.5 | 99.8 | 57.2 | 88.3 | 84.0 | 85.5 | High |
| **NAN5** | 2012 | 65.1 | 90.5 | 42.3 | 64.9 | 0.0 | 52.6 | Moderate |
| **NAN6** | 2012 | 79.2 | 80.8 | 46.5 | 41.9 | 38.5 | 57.4 | Moderate |
| **NAN7** | 2012 | 75.0 | 95.0 | 39.4 | 81.3 | 72.6 | 72.7 | High-Moderate |
| **NAN8** | 2012 | 71.4 | 76.1 | 39.3 | 84.7 | 85.1 | 71.3 | High |
| **SES 1** | 2012 | 84.2 | 80.4 | 43.6 | 0.0 | 45.4 | 50.7 | Moderate |
| **SES 2** | 2012 | 88.9 | 80.4 | 14.1 | 17.4 | 55.7 | 51.3 | Moderate |
| **SES 3** | 2012 | 95.4 | 80.4 | 36.7 | 17.8 | 71.3 | 60.3 | Moderate |
| **SES 4** | 2012 | 93.6 | 80.4 | 30.2 | 0.3 | 66.2 | 54.2 | Moderate |
| **High Quality = >69; High/Moderate = 61-69; Moderate = 39-61; Moderate/Fair = 31-39; Fair/Poor = <31** | | | | | | | | |

**Table 7b.** 2012 Trophic Health Index Scores and status for water quality monitoring stations in Nantucket estuaries based upon open water embayment (not salt marsh) habitat quality scales. Index calculated *with* Dissolved Oxygen data (described in Howes et. al., 1999 at www.savebuzzardsbay.org).

| ID | Secchi SCORE | Low20% Oxsat SCORE | DIN SCORE | TON SCORE | T-Pig SCORE | EUTRO Index | Health Status |
|---|---|---|---|---|---|---|---|
| HUM1 | 54.0 | 41.6 | 100.0 | 4.3 | 2.4 | 40.4 | Moderate |
| HUM3 | 48.5 | 49.6 | 75.2 | 8.2 | 0.0 | 36.3 | Moderate-Fair |
| HUM5 | 25.9 | 41.7 | 77.7 | 0.0 | 0.0 | 29.0 | Fair-Poor |
| HUM7 | 22.4 | 14.5 | 0.4 | 0.0 | 0.0 | 7.4 | Fair-Poor |
| HUM8 | 12.2 | 42.6 | 55.2 | 0.0 | 0.0 | 22.0 | Fair-Poor |
| LONG5 | 0.6 | 55.8 | 100.0 | 0.0 | 0.0 | 31.3 | Moderate-Fair |
| LONG6 | 4.6 | 55.8 | 73.9 | 0.0 | 0.0 | 26.8 | Fair-Poor |
| MH1 | 59.0 | 0.3 | 44.5 | 5.4 | 0.0 | 21.8 | Fair-Poor |
| MH2 | 72.8 | 22.3 | 70.7 | 50.3 | 5.4 | 44.3 | Moderate |
| MH3 | 83.3 | 40.5 | 72.7 | 92.1 | 40.5 | 65.8 | High-Moderate |
| MH4 | 100.0 | 40.5 | 72.4 | 100.0 | 71.8 | 77.0 | High |
| MP1 | 54.8 | 37.1 | 63.7 | 0.0 | 0.0 | 31.1 | Moderate-Fair |
| MP2 | 70.3 | 55.6 | 47.9 | 0.0 | 0.0 | 34.8 | Moderate-Fair |
| MP3 | 47.1 | 42.8 | 12.9 | 0.0 | 0.0 | 20.6 | Fair-Poor |
| NAN1 | 100.0 | 23.0 | 66.7 | 90.1 | 76.1 | 71.2 | High |
| NAN2 | 100.0 | 20.9 | 87.2 | 100.0 | 51.8 | 72.0 | High |
| NAN3 | 95.5 | 33.4 | 66.4 | 66.3 | 23.0 | 56.9 | Moderate |
| NAN4 | 100.0 | 32.8 | 68.0 | 100.0 | 73.0 | 74.8 | High |
| NAN5 | 74.8 | 12.5 | 62.1 | 54.1 | 0.0 | 40.7 | Moderate |
| NAN6 | 81.7 | 16.6 | 69.8 | 49.9 | 0.0 | 43.6 | Moderate |
| NAN7 | 78.1 | 27.1 | 72.3 | 70.4 | 25.6 | 54.7 | Moderate |
| NAN8 | 86.7 | 27.5 | 62.3 | 100.0 | 77.6 | 70.8 | High |
| SESA1 | 62.1 | 42.3 | 82.2 | 0.0 | 18.5 | 41.0 | Moderate |
| SESA2 | 54.3 | 42.3 | 71.4 | 0.0 | 27.4 | 39.1 | Moderate |
| SESA3 | 55.9 | 42.0 | 70.2 | 0.0 | 22.7 | 38.2 | Moderate-Fair |
| SESA4 | 54.8 | 42.5 | 71.3 | 0.0 | 32.9 | 40.3 | Moderate |

High Quality = >69; High/Moderate = 61-69; Moderate = 39-61; Moderate/Fair = 31-39; Fair/Poor = <31

**Table 7c.** 2010 Trophic Health Index Scores and status for water quality monitoring stations in Nantucket estuaries based upon open water embayment (not salt marsh) habitat quality scales. Index calculated *with* Dissolved Oxygen data (described in Howes et. al., 1999 at www.savebuzzardsbay.org).

| Sta ID | Secchi SCORE | DIN SCORE | TON SCORE | T-Pig SCORE | No DO EUTRO Index | Health Status |
|---|---|---|---|---|---|---|
| **HUM-1** | 29.6 | 47.1 | 0.0 | 16.9 | 23.4 | Fair-Poor |
| **HUM-3** | 30.2 | 18.9 | 0.0 | 26.8 | 19.0 | Fair-Poor |
| **HUM-5** | 0.0 | 20.1 | 0.0 | 15.8 | 9.0 | Fair-Poor |
| **HUM-7** | 0.8 | 19.8 | 0.0 | 0.0 | 5.2 | Fair-Poor |
| **HUM-8** | 0.0 | 36.3 | 0.0 | 20.1 | 14.1 | Fair-Poor |
| **LONG-5** | 11.2 | 81.0 | 0.0 | 17.3 | 27.4 | Fair-Poor |
| **LONG-6** | 9.3 | 74.8 | 0.0 | 1.1 | 21.3 | Fair-Poor |
| **MH1** | 64.5 | 33.4 | 22.0 | 71.2 | 47.8 | Moderate |
| **MH2** | 69.3 | 75.1 | 91.8 | 100.0 | 84.0 | High |
| **MH3** | 73.6 | 86.5 | 93.0 | 100.0 | 88.3 | High |
| **MH4** | 99.0 | 79.3 | 100.0 | 100.0 | 94.6 | High |
| **MP1** | 31.0 | 83.7 | 0.0 | 0.0 | 28.7 | Fair-Poor |
| **MP2** | 41.9 | 44.1 | 0.0 | 0.0 | 21.5 | Fair-Poor |
| **MP3** | 27.3 | 0.0 | 0.0 | 0.0 | 6.8 | Fair-Poor |
| **NAN1** | 100.0 | 88.4 | 100.0 | 100.0 | 97.1 | High |
| **NAN2** | 97.3 | 75.7 | 82.0 | 83.1 | 84.5 | High |
| **NAN3** | 89.9 | 84.1 | 54.8 | 36.9 | 66.4 | High-Moderate |
| **NAN4** | 100.0 | 81.4 | 93.1 | 100.0 | 93.6 | High |
| **NAN5** | 70.7 | 91.3 | 64.3 | 48.0 | 68.6 | High-Moderate |
| **NAN6** | 76.1 | 72.4 | 61.9 | 44.2 | 63.6 | High-Moderate |
| **NAN7** | 70.0 | 90.9 | 88.6 | 64.4 | 78.4 | High |
| **NAN8** | 78.6 | 64.2 | 100.0 | 100.0 | 85.7 | High |
| **SES 1** | 78.9 | 40.3 | 0.0 | 62.4 | 45.4 | Moderate |
| **SES 2** | 86.4 | 61.6 | 2.8 | 73.5 | 56.1 | Moderate |
| **SES 3** | 88.0 | 52.5 | 0.0 | 80.7 | 55.3 | Moderate |
| **SES 4** | 92.1 | 47.9 | 0.0 | 79.9 | 55.0 | Moderate |

**Table 8a.** 2013 Trophic Health Index Scores and status for water quality monitoring stations in Nantucket estuaries based upon open water embayment (not salt marsh) habitat quality scales. Index calculated *without* Dissolved Oxygen data (described in Howes et. al., 1999 at www.savebuzzardsbay.org).

| Station ID | Year | Secchi SCORE | DIN SCORE | TON SCORE | T-Pig SCORE | EUTRO Index | Health Status |
|---|---|---|---|---|---|---|---|
| **HUM-1** | 2012 | 30.8 | 45.0 | 0.0 | 12.0 | 22.0 | Fair-Poor |
| **HUM-3** | 2012 | 41.0 | 52.8 | 0.0 | 16.0 | 27.4 | Fair-Poor |
| **HUM-5** | 2012 | 17.5 | 47.3 | 0.0 | 0.0 | 16.2 | Fair-Poor |
| **HUM-7** | 2012 | 11.3 | 7.9 | 0.0 | 0.0 | 4.8 | Fair-Poor |
| **HUM-8** | 2012 | 1.0 | 38.0 | 0.0 | 0.0 | 9.7 | Fair-Poor |
| **LONG-5** | 2012 | 0.0 | 30.4 | 0.0 | 0.0 | 7.6 | Fair-Poor |
| **LONG-6** | 2012 | 0.0 | 39.3 | 0.0 | 21.9 | 15.3 | Fair-Poor |
| **MH1** | 2012 | 65.3 | 3.0 | 17.6 | 3.1 | 22.3 | Fair-Poor |
| **MH2** | 2012 | 83.2 | 20.1 | 68.4 | 100.0 | 67.9 | High-Moderate |
| **MH3** | 2012 | 84.8 | 27.7 | 99.0 | 100.0 | 77.9 | High |
| **MH4** | 2012 | 100.0 | 53.8 | 100.0 | 100.0 | 88.4 | High |
| **MP1** | 2012 | 55.3 | 36.2 | 0.0 | 0.0 | 22.9 | Fair-Poor |
| **MP2** | 2012 | 55.4 | 23.2 | 0.0 | 0.0 | 19.7 | Fair-Poor |
| **MP3** | 2012 | 31.0 | 6.7 | 0.0 | 0.0 | 9.4 | Fair-Poor |
| **NAN1** | 2012 | 100.0 | 40.2 | 100.0 | 79.4 | 79.9 | High |
| **NAN2** | 2012 | 98.9 | 32.5 | 89.4 | 83.0 | 76.0 | High |
| **NAN3** | 2012 | 85.2 | 50.7 | 63.0 | 76.7 | 68.9 | High-Moderate |
| **NAN4** | 2012 | 98.5 | 57.2 | 88.3 | 84.0 | 82.0 | High |
| **NAN5** | 2012 | 65.1 | 42.3 | 64.9 | 0.0 | 43.1 | Moderate |
| **NAN6** | 2012 | 79.2 | 46.5 | 41.9 | 38.5 | 51.5 | Moderate |
| **NAN7** | 2012 | 75.0 | 39.4 | 81.3 | 72.6 | 67.1 | High-Moderate |
| **NAN8** | 2012 | 71.4 | 39.3 | 84.7 | 85.1 | 70.1 | High |
| **SES 1** | 2012 | 84.2 | 43.6 | 0.0 | 45.4 | 43.3 | Moderate |
| **SES 2** | 2012 | 88.9 | 14.1 | 17.4 | 55.7 | 44.1 | Moderate |
| **SES 3** | 2012 | 95.4 | 36.7 | 17.8 | 71.3 | 55.3 | Moderate |
| **SES 4** | 2012 | 93.6 | 30.2 | 0.3 | 66.2 | 47.6 | Moderate |
| **High Quality = >69; High/Moderate = 61-69; Moderate = 39-61; Moderate/Fair = 31-39; Fair/Poor = <31** | | | | | | | |

**Table 8b.** 2012Trophic Health Index Scores and status for water quality monitoring stations in Nantucket estuaries based upon open water embayment (not salt marsh) habitat quality scales. Index calculated *without* Dissolved Oxygen data (described in Howes et. al., 1999 at www.savebuzzardsbay.org).

| ID | Secchi SCORE | DIN SCORE | TON SCORE | T-Pig SCORE | EUTRO Index | Health Status |
|---|---|---|---|---|---|---|
| HUM1 | 54.0 | 100.0 | 4.3 | 2.4 | 40.1 | Moderate |
| HUM3 | 48.5 | 75.2 | 8.2 | 0.0 | 33.0 | Moderate-Fair |
| HUM5 | 25.9 | 77.7 | 0.0 | 0.0 | 25.9 | Fair-Poor |
| HUM7 | 22.4 | 0.4 | 0.0 | 0.0 | 5.7 | Fair-Poor |
| HUM8 | 12.2 | 55.2 | 0.0 | 0.0 | 16.9 | Fair-Poor |
| LONG5 | 0.6 | 100.0 | 0.0 | 0.0 | 25.2 | Fair-Poor |
| LONG6 | 4.6 | 73.9 | 0.0 | 0.0 | 19.6 | Fair-Poor |
| MH1 | 59.0 | 44.5 | 5.4 | 0.0 | 27.2 | Fair-Poor |
| MH2 | 72.8 | 70.7 | 50.3 | 5.4 | 49.8 | Moderate |
| MH3 | 83.3 | 72.7 | 92.1 | 40.5 | 72.1 | High |
| MH4 | 100.0 | 72.4 | 100.0 | 71.8 | 86.1 | High |
| MP1 | 54.8 | 63.7 | 0.0 | 0.0 | 29.6 | Fair-Poor |
| MP2 | 70.3 | 47.9 | 0.0 | 0.0 | 29.6 | Fair-Poor |
| MP3 | 47.1 | 12.9 | 0.0 | 0.0 | 15.0 | Fair-Poor |
| NAN1 | 100.0 | 66.7 | 90.1 | 76.1 | 83.3 | High |
| NAN2 | 100.0 | 87.2 | 100.0 | 51.8 | 84.7 | High |
| NAN3 | 95.5 | 66.4 | 66.3 | 23.0 | 62.8 | High-Moderate |
| NAN4 | 100.0 | 68.0 | 100.0 | 73.0 | 85.3 | High |
| NAN5 | 74.8 | 62.1 | 54.1 | 0.0 | 47.8 | Moderate |
| NAN6 | 81.7 | 69.8 | 49.9 | 0.0 | 50.4 | Moderate |
| NAN7 | 78.1 | 72.3 | 70.4 | 25.6 | 61.6 | High-Moderate |
| NAN8 | 86.7 | 62.3 | 100.0 | 77.6 | 81.7 | High |
| SESA1 | 62.1 | 82.2 | 0.0 | 18.5 | 40.7 | Moderate |
| SESA2 | 54.3 | 71.4 | 0.0 | 27.4 | 38.3 | Moderate-Fair |
| SESA3 | 55.9 | 70.2 | 0.0 | 22.7 | 37.2 | Moderate-Fair |
| SESA4 | 54.8 | 71.3 | 0.0 | 32.9 | 39.8 | Moderate |
| High Quality = >69; High/Moderate = 61-69; Moderate = 39-61; Moderate/Fair = 31-39; Fair/Poor = <31 | | | | | | |

**Table 8c. 2010**Trophic Health Index Scores and status for water quality monitoring stations in Nantucket estuaries based upon open water embayment (not salt marsh) habitat quality scales. Index calculated ***without*** Dissolved Oxygen data (described in Howes et. al., 1999 at www.savebuzzardsbay.org).

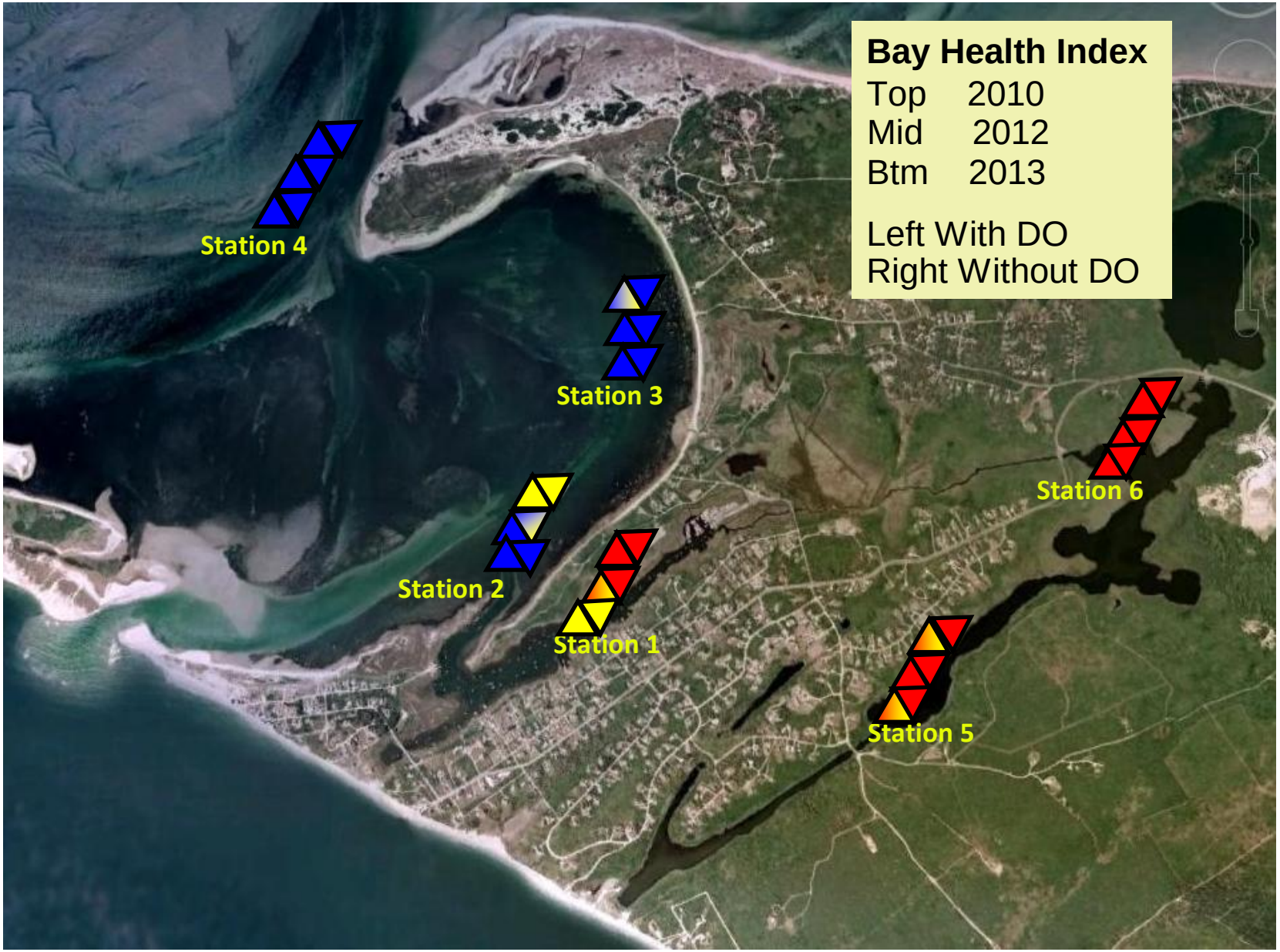



Figure 10. Madaket Harbor Eutrophication Index 2010 (top pair of triangles) and 2013 (bottom pair of triangles). Index was calculated with (left of each pair) and without (right of each pair) including dissolved oxygen, due to the limited amount of oxygen measurements (2010-8 events, 2012-4 events, 2013-5 events). Colors indicate High (Blue), Moderate (Yellow), Fair/Poor (Red) nutrient related water quality.

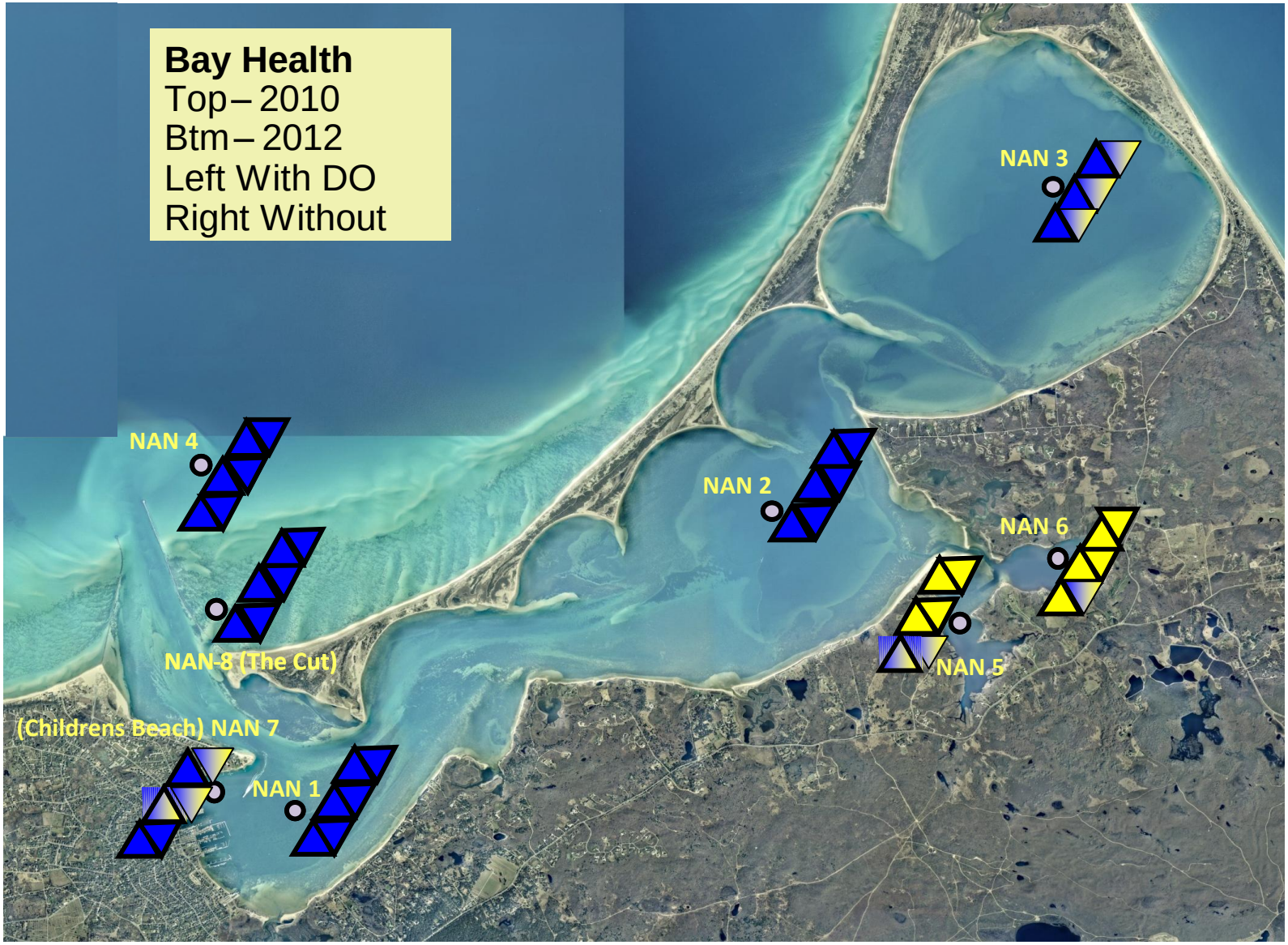



Figure 11. Nantucket Harbor Eutrophication Index 2010 (top pair of triangles) and 2012 (bottom pair of triangles). Index was calculated with (left of each pair) and without (right of each pair) including dissolved oxygen, due to the limited amount of oxygen measurements (2010, 10 events; 2012, 7 events; 2013, 5 events). Colors indicate High (Blue), Moderate (Yellow), Fair/Poor (Red) nutrient related water quality.

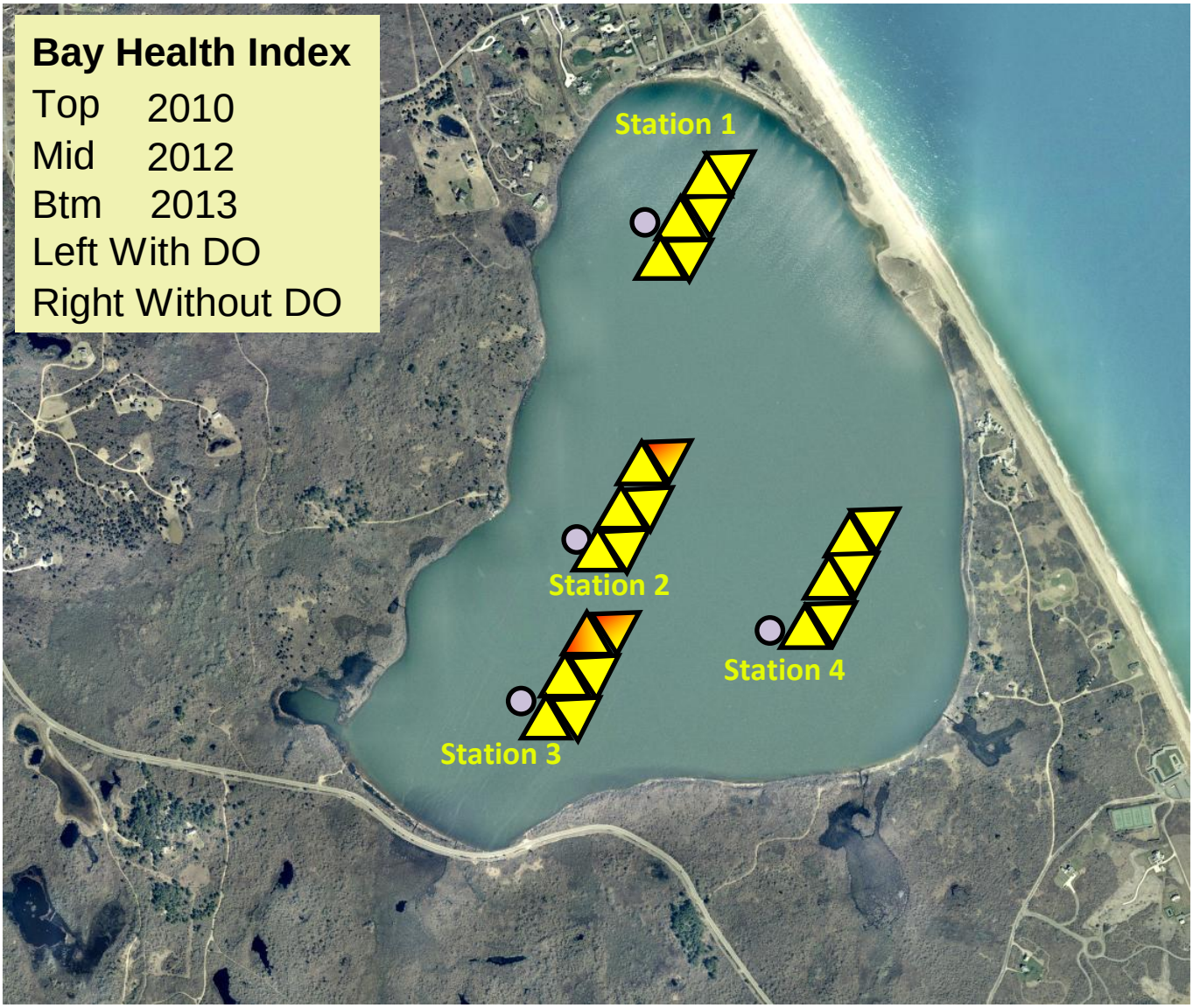



Figure 12. Sesachacha Pond Eutrophication Index 2010 (top pair of triangles) and 2013 (bottom pair of triangles). Index was calculated with (left of each pair) and without (right of each pair) including dissolved oxygen, due to the limited amount of oxygen measurements (2010, 5 events; 2012, 4 events; 2013, 5 events). Colors indicate High (Blue), Moderate (Yellow), Fair/Poor (Red) nutrient related water quality

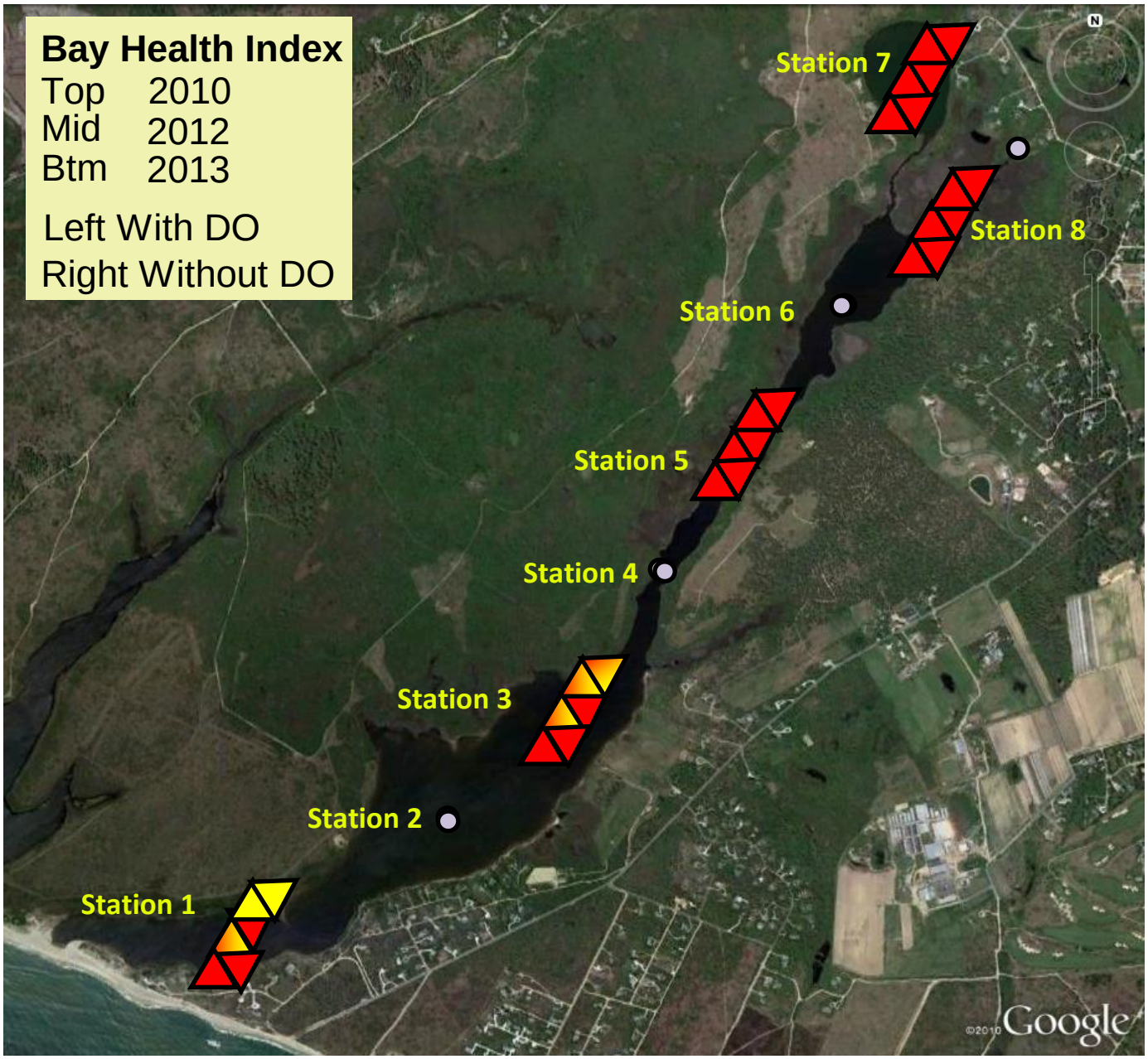



Figure 13. Hummock Pond Eutrophication Index 2010 (top pair of triangles) and 2013 (bottom pair of triangles). Index was calculated with (left of each pair) and without (right of each pair) including dissolved oxygen, due to the limited amount of oxygen measurements (2010, 5 events; 2012, 4 events; 2013, 5 events). Colors indicate High (Blue), Moderate (Yellow), Fair/Poor (Red) nutrient related water quality.

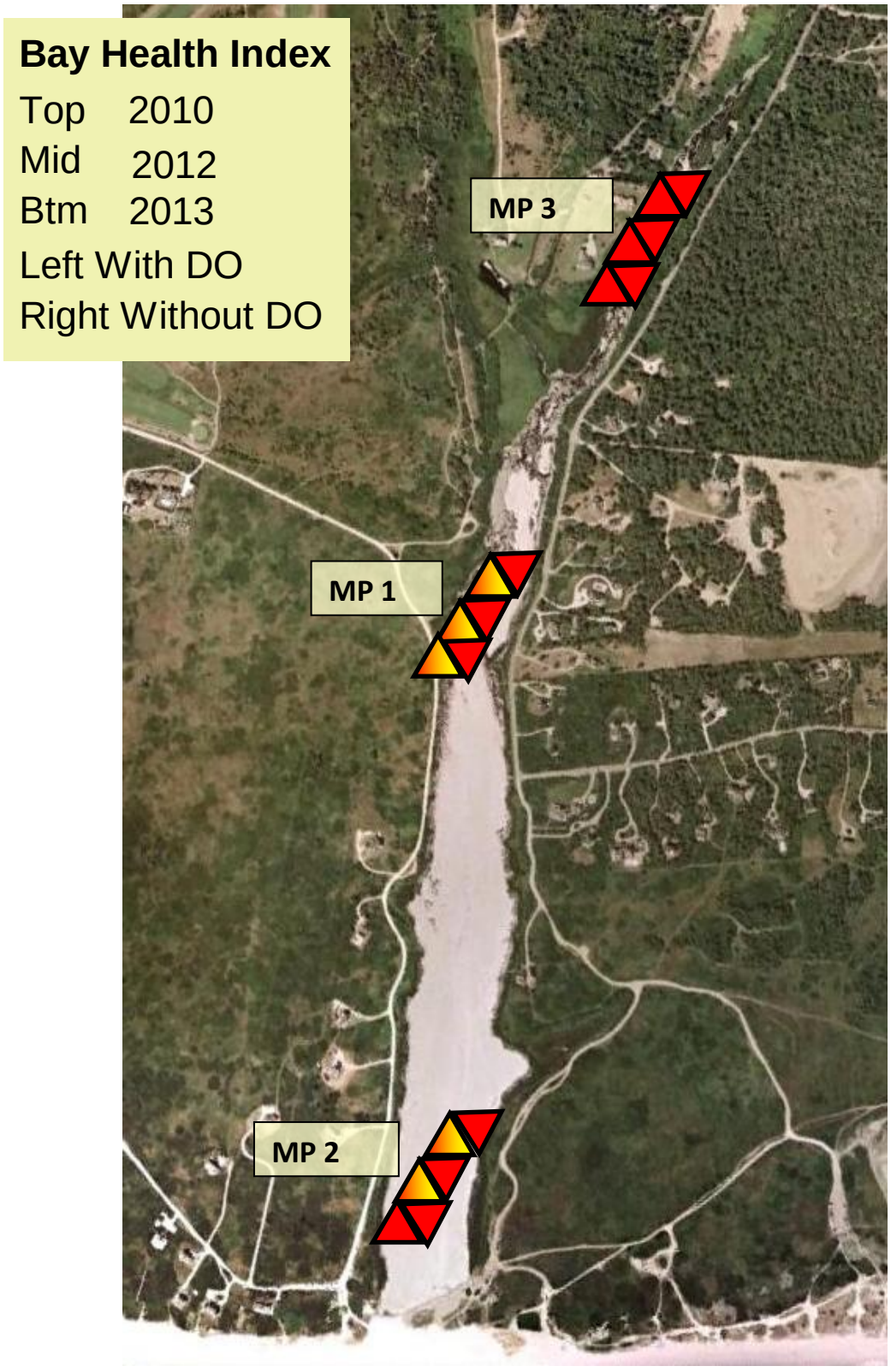



Figure 14. Miacomet Pond Eutrophication Index 2010 (top pair of triangles) and 2013 (bottom pair of triangles). Index was calculated with (left of each pair) and without (right of each pair) including dissolved oxygen, due to the limited amount of oxygen measurements (2010, 5 events; 2012, 4 events; 2013 5 events). Colors indicate High (Blue), Moderate (Yellow), Fair/Poor (Red) nutrient related water quality.

# APPENDIX A

Results of Summer 2011 Water Quality Monitoring

Samples Collected by the Nantucket Marine and Coastal Resources Department

Samples Analyzed by the Wampanoag Environmental Laboratory

# Nantucket Harbor (NAN 1-4)

| Lab ID | Sample Date | Salinity (mg/L) | Particulate organic nitrogen (mg/L) | Nitrite (mg/L) | Nitrate (mg/L) | KJEHLDAHL NITROGEN (mg/L) | Ammonium (mg/L) | CHLOROPHYLL a (mg/L) | Pheophytin-a (mg/L) | Orthophosphate (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| NAN1 BOTTOM | 6/9/2011 | 33.7 | 0.69 | <0.0015 | <0.05 | 0.260 | <0.05 | 3.7 | 2.1 | 0.06 |
| NAN1 BOTTOM | 6/24/2011 | 34.3 | 0.09 | 0.0028 | <0.05 | 0.710 | <0.05 | 4.4 | 2.1 | 0.42 |
| NAN1 BOTTOM | 7/5/2011 | 34.3 | 0.42 | 0.0031 | 0.02 | 0.050 | <0.05 | 5.8 | 1.3 | 0.17 |
| NAN1 BOTTOM | 7/20/2011 | 34.6 | 0.08 | 0.0022 | 0.02 | 0.230 | <0.015 | 5.4 | 1.4 | 0.42 |
| NAN1 BOTTOM | 9/14/2011 | 34.6 | 0.16 | < | < | 0.210 | < | 6.1 | 1.1 | 1.63 |
| NAN1 SURFACE | 6/9/2011 | 33.4 | 0.49 | 0.006 | <0.05 | 0.890 | <0.05 | 5.6 | 1.2 | 0.19 |
| NAN1 SURFACE | 6/24/2011 | 34.1 | 0.05 | 0.0046 | <0.05 | 0.620 | <0.05 | 5.3 | 2.1 | 0.49 |
| NAN1 SURFACE | 7/5/2011 | 34.3 | 0.61 | 0.0048 | 0.03 | 0.050 | <0.05 | 5.8 | 1.3 | 0.38 |
| NAN1 SURFACE | 7/20/2011 | 34.4 | 0.09 | 0.0027 | 0.03 | 0.140 | <0.015 | 5.4 | 1.6 | 0.4 |
| NAN1 SURFACE | 9/14/2011 | 34.4 | 0.14 | < | < | 0.110 | < | 4.2 | 1.6 | 1.62 |
| NAN2 BOTTOM | 6/9/2011 | 34.2 | 0.79 | 0.0046 | <0.05 | 0.220 | <0.05 | 6 | 3.2 | 0.05 |
| NAN2 BOTTOM | 6/24/2011 | 34.7 | 0.08 | 0.0009 | <0.05 | 0.28 | <0.05 | 3.2 | 2.4 | 0.43 |
| NAN2 BOTTOM | 7/5/2011 | 34.4 | 0.19 | 0.0024 | 0.03 | 0.12 | <0.05 | 8.6 | 2.8 | 0.057 |
| NAN2 BOTTOM | 7/20/2011 | 35 | 0.05 | 0.0022 | 0.02 | 0.24 | <0.015 | 8 | 2.1 | 0.35 |
| NAN2 BOTTOM | 9/14/2011 | 34.7 | 0.31 | < | < | 0.14 | < | 4.1 | 2.3 | 2.23 |
| NAN2 SURFACE | 6/9/2011 | 34.2 | 0.84 | 0.0095 | <0.05 | 0.410 | <0.05 | 5.2 | 2.6 | 0.21 |
| NAN2 SURFACE | 6/24/2011 | 34.6 | 0.05 | 0.0019 | <0.05 | 0.400 | <0.05 | 7.6 | 3.6 | 0.17 |
| NAN2 SURFACE | 7/5/2011 | 34.5 | 0.11 | 0.0045 | 0.01 | 0.940 | <0.05 | 7.6 | 1.4 | 0.3 |
| NAN2 SURFACE | 7/20/2011 | 35 | 0.05 | 0.0013 | 0.04 | 0.190 | <0.015 | 8.2 | 2.1 | 0.49 |
| NAN2 SURFACE | 9/14/2011 | 34.7 | 0.29 | < | 0.06 | 0.160 | < | 7.3 | 1.4 | 1.38 |
| NAN3 BOTTOM | 6/9/2011 | 34.5 | 0.41 | 0.003 | <0.05 | 0.660 | <0.05 | 5.1 | 4.1 | 0.12 |
| NAN3 BOTTOM | 6/24/2011 | 34.8 | 0.04 | 0.0031 | <0.05 | 0.860 | <0.05 | 7 | 4.1 | 0.4 |
| NAN3 BOTTOM | 7/5/2011 | 34.9 | 0.16 | 0.0027 | 0.03 | 0.110 | <0.05 | 6.6 | 1.2 | 0.68 |
| NAN3 BOTTOM | 7/20/2011 | 34.9 | 0.09 | 0.0033 | 0.05 | 0.130 | <0.015 | 7.1 | 2.2 | 0.55 |
| NAN3 BOTTOM | 9/14/2011 | 35.1 | 0.11 | < | < | 0.090 | < | 5 | 1.3 | 1.91 |
| NAN3 SURFACE | 6/9/2011 | 34.4 | 0.68 | 0.0065 | <0.05 | 0.14 | <0.05 | 5.7 | 3.2 | 0.14 |
| NAN3 SURFACE | 6/24/2011 | 34.9 | 0.06 | 0.0029 | <0.05 | 0.140 | <0.05 | 41.1 | 21.6 | 0.02 |
| NAN3 SURFACE | 7/5/2011 | 34.9 | 0.24 | 0.0021 | 0.03 | 0.140 | <0.05 | 8.4 | 3.6 | 0.62 |
| NAN3 SURFACE | 7/20/2011 | 35.1 | 0.06 | 0.0036 | 0.02 | 0.160 | <0.015 | 8.4 | 2.3 | 0.59 |
| NAN3 SURFACE | 9/14/2011 | 35 | 0.26 | < | < | 0.130 | < | 5.2 | 1.6 | 1.53 |
| NAN4 BOTTOM | 6/9/2011 | 34.3 | 0.21 | 0.0052 | <0.05 | 0.610 | <0.05 | 4.2 | 2.3 | <0.05 |
| NAN4 BOTTOM | 6/24/2011 | 34.8 | 0.09 | 0.0014 | <0.05 | 0.36 | <0.05 | 4 | 2 | 0.45 |
| NAN4 BOTTOM | 7/5/2011 | 34.8 | 0.22 | 0.0024 | 0.02 | 0.81 | <0.05 | 3.7 | 1.7 | 0.6 |
| NAN4 BOTTOM | 7/20/2011 | 34.6 | 0.05 | 0.00334 | 0.04 | 0.66 | <0.015 | 2.8 | < | 0.48 |
| NAN4 BOTTOM | 9/14/2011 | 34.3 | 0.05 | < | < | 0.17 | < | 5.3 | 3.2 | 1.52 |
| NAN4 SURFACE | 6/9/2011 | 34.2 | 0.42 | 0.0067 | <0.05 | 0.110 | <0.05 | 4 | 2 | 0.08 |
| NAN4 SURFACE | 6/24/2011 | 34.8 | 0.06 | 0.0008 | <0.05 | 0.490 | <0.05 | 4.7 | 2.6 | 0.37 |
| NAN4 SURFACE | 7/5/2011 | 34.8 | 0.21 | 0.0018 | 0.03 | 0.130 | <0.05 | 3.6 | 1.9 | 0.82 |
| NAN4 SURFACE | 7/20/2011 | 34.5 | 0.05 | 0.0021 | 0.02 | 0.220 | <0.015 | 2.9 | < | 0.26 |
| NAN4 SURFACE | 9/14/2011 | 35.3 | 0.09 | < | < | 0.220 | < | 6.6 | 2.1 | 1.45 |

# Nantucket Harbor (NAN 5-9)

| Lab ID | Sample Date | Salinity (mg/L) | Particulate organic nitrogen (mg/L) | Nitrite (mg/L) | Nitrate (mg/L) | KJEHLDAHL NITROGEN (mg/L) | Ammonium (mg/L) | CHLOROPHYLL a (mg/L) | **Pheophytin-a** (mg/L) | Orthophosphate (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| NAN5 BOTTOM | 6/9/2011 | 34.3 | 0.39 | 0.0052 | <0.05 | 0.32 | <0.05 | 3.5 | 2.6 | 0.06 |
| NAN5 BOTTOM | 6/24/2011 | 33.7 | 0.08 | 0.0021 | <0.05 | 0.200 | <0.05 | 7 | 2.6 | 0.42 |
| NAN5 BOTTOM | 7/5/2011 | 34.5 | 0.18 | 0.0031 | 0.03 | 0.240 | <0.05 | 7.1 | 3.3 | 0.4 |
| NAN5 BOTTOM | 7/20/2011 | 34.4 | 0.05 | 0.001 | 0.02 | 0.120 | <0.015 | 7.2 | 2.3 | 0.64 |
| NAN5 BOTTOM | 9/14/2011 | 35 | 0.24 | < | < | 0.050 | < | 8 | 3.1 | 1.82 |
| NAN5 SURFACE | 6/9/2011 | 34.1 | 0.64 | 0.0064 | <0.05 | 0.110 | <0.05 | 4.5 | 2.6 | <0.05 |
| NAN5 SURFACE | 6/24/2011 | 33.5 | 0.14 | 0.0035 | <0.05 | 0.240 | <0.05 | 6.3 | 3.1 | 0.28 |
| NAN5 SURFACE | 7/5/2011 | 33.9 | 0.14 | 0.0022 | 0.03 | 0.160 | <0.05 | 6.5 | 2.1 | 0.4 |
| NAN5 SURFACE | 7/20/2011 | 34.1 | 0.07 | 0.0006 | 0.05 | 0.420 | <0.015 | 7.2 | 2.4 | 0.45 |
| NAN5 SURFACE | 9/14/2011 | 34.9 | 0.17 | < | 0.06 | 0.050 | < | 8.7 | 3.6 | 1.32 |
| NAN6 BOTTOM | 6/9/2011 | 34.5 | 0.24 | 0.0047 | <0.05 | 0.050 | <0.05 | 4.2 | 2 | 0.09 |
| NAN6 BOTTOM | 6/24/2011 | 34 | 0.11 | 0.0027 | <0.05 | 0.22 | <0.05 | 5.7 | 2.8 | 0.32 |
| NAN6 BOTTOM | 7/5/2011 | 34.4 | 0.14 | 0.0019 | 0.02 | 0.23 | <0.05 | 7.3 | 4.8 | 0.37 |
| NAN6 BOTTOM | 7/20/2011 | 34.5 | 0.08 | 0.002 | 0.03 | 0.31 | <0.015 | 7.2 | 1.3 | 0.31 |
| NAN6 BOTTOM | 9/14/2011 | 34.9 | 0.29 | < | < | 0.09 | < | 5.9 | 3 | 1.9 |
| NAN6 SURFACE | 6/9/2011 | 34.4 | 0.63 | 0.0053 | <0.05 | 0.420 | <0.05 | 4.7 | 1.9 | 0.11 |
| NAN6 SURFACE | 6/24/2011 | 34 | 0.09 | 0.003 | <0.05 | 0.890 | <0.05 | 6.7 | 2.4 | 0.36 |
| NAN6 SURFACE | 7/5/2011 | 34.3 | 0.09 | 0.0053 | 0.04 | 0.190 | <0.05 | 6.9 | 2.6 | 0.41 |
| NAN6 SURFACE | 7/20/2011 | 34.5 | 0.06 | 0.0013 | 0.03 | 0.210 | <0.015 | 6.4 | 1.6 | 0.51 |
| NAN6 SURFACE | 9/14/2011 | 34.9 | 0.11 | < | < | 0.160 | < | 9 | 4.2 | 1.62 |
| NAN7 BOTTOM | 6/9/2011 | 34.6 | 0.82 | 0.0043 | <0.05 | 0.940 | <0.05 | 3 | 3.2 | 0.08 |
| NAN7 BOTTOM | 6/24/2011 | 34.4 | 0.07 | 0.002 | <0.05 | 0.080 | <0.05 | 4.8 | 2 | 0.34 |
| NAN7 BOTTOM | 7/5/2011 | 34.5 | 0.39 | 0.0023 | 0.03 | 0.630 | <0.05 | 6.4 | 1.1 | 0.55 |
| NAN7 BOTTOM | 7/20/2011 | 34.7 | 0.05 | 0.0031 | 0.03 | 0.390 | <0.015 | 6.8 | 2.1 | 0.2 |
| NAN7 BOTTOM | 9/14/2011 | 35 | 0.14 | < | 0.06 | 0.100 | < | 6 | 2.7 | 2.16 |
| NAN7 SURFACE | 6/9/2011 | 34.5 | 0.51 | 0.0049 | <0.05 | 0.130 | <0.05 | 5.3 | 3.6 | <0.05 |
| NAN7 SURFACE | 6/24/2011 | 34.4 | 0.11 | 0.002 | <0.05 | 0.090 | <0.05 | 5.1 | 2 | 0.67 |
| NAN7 SURFACE | 7/5/2011 | 34.4 | 0.26 | 0.0031 | 0.04 | 0.110 | <0.05 | 6.3 | 1.6 | 0.45 |
| NAN7 SURFACE | 7/20/2011 | 34.4 | 0.07 | 0.0028 | 0.05 | 0.240 | <0.015 | 7 | 2 | 0.53 |
| NAN7 SURFACE | 9/14/2011 | 35.1 | 0.16 | < | < | 0.130 | < | 6.6 | 2.8 | 1.58 |
| NAN8 BOTTOM | 6/9/2011 | 34.6 | 0.24 | 0.0054 | <0.05 | 0.060 | <0.05 | 5.5 | 3.6 | 0.09 |
| NAN8 BOTTOM | 6/24/2011 | 34.5 | 0.11 | 0.0022 | <0.05 | 0.16 | <0.05 | 4.5 | 3 | 0.29 |
| NAN8 BOTTOM | 7/5/2011 | 34.8 | 0.33 | 0.0046 | 0.03 | 0.18 | <0.05 | 4.4 | 1.1 | 0.53 |
| NAN8 BOTTOM | 7/20/2011 | 26.5 | 0.05 | 0.0024 | 0.04 | 0.11 | <0.015 | 4.9 | 1 | 0.49 |
| NAN8 BOTTOM | 9/14/2011 | 35.2 | 0.05 | < | < | 0.15 | < | 5.8 | 1.7 | 2 |
| NAN8 SURFACE | 6/9/2011 | 34.6 | 0.66 | 0.0039 | <0.05 | 0.630 | <0.05 | 3.9 | 2.1 | 0.14 |
| NAN8 SURFACE | 6/24/2011 | 34.6 | 0.09 | 0.0023 | <0.05 | 0.140 | <0.05 | 6.6 | 3.1 | 0.54 |
| NAN8 SURFACE | 7/5/2011 | 34.5 | 0.24 | 0.0035 | 0.03 | 0.210 | <0.05 | 6.4 | 2.3 | 0.47 |
| NAN8 SURFACE | 7/20/2011 | 34.8 | 0.05 | 0.0039 | 0.02 | 0.270 | <0.015 | 4.2 | 1 | 0.6 |
| NAN8 SURFACE | 9/14/2011 | 35.2 | 0.05 | < | 0.09 | 0.200 | < | 5.8 | 1.8 | 2.39 |
| NAN9 BOTTOM | 7/20/2011 | 34.4 | 0.05 | 0.0026 | 0.03 | 0.09 | <0.015 | 6.2 | 2.3 | 0.5 |
| NAN9 BOTTOM | 9/14/2011 | 34.9 | 0.22 | < | < | 0.05 | < | 5.3 | 2.3 | 1.45 |
| NAN9 SURFACE | 7/20/2011 | 34.4 | 0.05 | 0.0018 | 0.03 | 0.08 | <0.015 | 6.1 | 2.3 | 0.42 |
| NAN9 SURFACE | 9/14/2011 | 34.8 | 0.21 | < | < | 0.05 | < | 4.8 | 2.2 | 2.12 |

## Madaket Harbor

| Lab ID | Sample Date | Salinity (mg/L) | Particulate organic nitrogen (mg/L) | Nitrite (mg/L) | Nitrate (mg/L) | KJEHLDAHL NITROGEN (mg/L) | Ammonium (mg/L) | CHLOROPHYLL a (mg/L) | Pheophytin-a (mg/L) | Orthophosphate (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| MH1 BOTTOM | 7/13/2011 | 33.6 | 0.62 | 0.0016 | 0.03 | 0.240 | < | 3.7 | 1 | 0.21 |
| MH1 BOTTOM | 9/13/2011 | 30.6 | 0.17 | 0.0037 | 0.01 | 0.210 | < | 13.2 | 8.1 | 1.58 |
| MH1 BOTTOM | 9/27/2011 | 2.7 | 0.26 | 0.0046 | < | 0.050 | < | 7.5 | 3.6 | 1.85 |
| MH1 BOTTOM | 6/16-6/17 | 31 | 0.14 | 0.0034 | <0.05 | 0.200 | <0.05 | 5.2 | 3.1 | 0.24 |
| MH1 SURFACE | 7/13/2011 | 32.2 | 0.49 | 0.0017 | 0.01 | 0.110 | < | 3.5 | 1.8 | 0.45 |
| MH1 SURFACE | 9/13/2011 | 25.4 | 0.23 | 0.0054 | 0.02 | 0.140 | < | 11.9 | 6.2 | 1.67 |
| MH1 SURFACE | 9/27/2011 | 2.7 | 0.14 | 0.0046 | < | 0.110 | < | 7.1 | 4.1 | 1.3 |
| MH1 SURFACE | 6/16-6/17 | 30.9 | 0.05 | 0.0048 | <0.05 | 0.190 | <0.05 | 6 | 4.8 | 0.39 |
| MH2 BOTTOM | 7/13/2011 | 34.1 | 0.31 | 0.0032 | 0.02 | 0.19 | < | 3.6 | 1.4 | 0.23 |
| MH2 BOTTOM | 9/13/2011 | 34.9 | 0.32 | 0.003 | 0.01 | 0.160 | < | 6.5 | 3.2 | 1.75 |
| MH2 BOTTOM | 9/27/2011 | 3.2 | 0.09 | 0.0029 | < | 0.070 | < | 6.1 | 4.3 | 1.46 |
| MH2 BOTTOM | 6/16-6/17 | 33.3 | 0.05 | 0.0032 | <0.05 | 0.160 | <0.05 | 5.1 | 1.6 | 0.36 |
| MH2 SURFACE | 7/13/2011 | 34.1 | 0.11 | 0.0026 | 0.02 | 0.160 | < | 3.2 | < | 0.29 |
| MH2 SURFACE | 9/13/2011 | 34.9 | 0.41 | 0.0032 | 0.1 | 0.180 | < | 6.1 | 4.1 | 2.22 |
| MH2 SURFACE | 9/27/2011 | 3.2 | 0.11 | 0.0029 | < | 0.09 | < | 4.8 | 2.1 | 1.44 |
| MH2 SURFACE | 6/16-6/17 | 33.2 | 0.05 | 0.004 | <0.05 | 0.240 | <0.05 | 3.9 | 2.6 | 0.32 |
| MH3 BOTTOM | 7/13/2011 | 34.5 | 0.14 | 0.0029 | 0.03 | 0.280 | < | 2.5 | 1 | 0.46 |
| MH3 BOTTOM | 9/13/2011 | 35.2 | 0.08 | 0.0042 | 0.07 | 0.060 | < | 7.3 | 2.3 | 1.73 |
| MH3 BOTTOM | 9/27/2011 | 1.7 | 0.24 | 0.005 | < | 0.080 | < | 10.1 | 4.6 | 1.51 |
| MH3 BOTTOM | 6/16-6/17 | 34.1 | 0.18 | 0.0043 | <0.05 | 0.06 | <0.05 | 6.8 | 4.1 | 0.33 |
| MH3 SURFACE | 7/13/2011 | 34.4 | 0.05 | 0.002 | 0.02 | 0.210 | < | 2.7 | 1.2 | 0.21 |
| MH3 SURFACE | 9/13/2011 | 35.1 | 0.11 | 0.0042 | 0.01 | 0.090 | < | 7.7 | 2.3 | 1.64 |
| MH3 SURFACE | 9/27/2011 | 1.6 | 0.06 | 0.003 | < | 0.100 | < | 10.5 | 4.9 | 2.57 |
| MH3 SURFACE | 6/16-6/17 | 34.1 | 0.21 | 0.0036 | <0.05 | 0.090 | <0.05 | 4.2 | 2 | 1.18 |
| MH4 BOTTOM | 7/13/2011 | 34.5 | 0.12 | 0.0043 | 0.02 | 0.09 | < | 2.3 | < | 0.41 |
| MH4 BOTTOM | 9/13/2011 | 35 | 0.09 | 0.0038 | 0.02 | 0.130 | < | 5 | 2.5 | 1.75 |
| MH4 BOTTOM | 6/16-6/17 | 34.1 | 0.05 | 0.0034 | <0.05 | 0.130 | <0.05 | 5.7 | 1.9 | 0.35 |
| MH4 SURFACE | 7/13/2011 | 34.5 | 0.09 | 0.0022 | 0.03 | 0.150 | < | 2.3 | 1 | 0.36 |
| MH4 SURFACE | 9/13/2011 | 35.1 | 0.16 | 0.0037 | 0.01 | 0.13 | < | 12.5 | 6.4 | 1.7 |
| MH4 SURFACE | 6/16-6/17 | 34.1 | 0.05 | 0.0045 | <0.05 | 0.140 | <0.05 | 11.1 | 2.6 | 0.18 |

## Long Pond

| Lab ID | Sample Date | Salinity (mg/L) | Particulate organic nitrogen (mg/L) | Nitrite (mg/L) | Nitrate (mg/L) | KJEHLDAHL NITROGEN (mg/L) | Ammonium (mg/L) | CHLOROPHYLL a (mg/L) | Pheophytin-a (mg/L) | Orthophosphate (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| LONG5 | 6/9/2011 | 14 | 0.42 | 0.0054 | <0.05 | 0.91 | 0.13 | 13.9 | 4.2 | 1.9 |
| LONG5 BOTTOM | 9/28/2011 | 0.09 | 0.09 | 0.0066 | < | 0.220 | < | 18 | 8.8 | 1.87 |
| LONG5 MID | 7/12/2011 | 16.2 | 0.09 | 0.0013 | 0.02 | 0.09 | 0.01 | 11.1 | 4.1 | 0.15 |
| LONG5 SURFACE | 9/28/2011 | 0.12 | 0.12 | 0.0091 | < | 0.140 | < | 18.2 | 9.3 | 1.34 |
| LONG6 | 6/9/2011 | 16.6 | 0.86 | 0.0062 | <0.05 | 0.240 | <0.05 | 18.6 | 9.6 | 2.6 |
| LONG6 BOTTOM | 9/28/2011 | 0.09 | 0.09 | 0.0013 | < | 0.090 | < | 15.2 | 3.2 | 1.44 |
| LONG6 MID | 7/12/2011 | 17.4 | 0.09 | < | 0.02 | 0.120 | 0.02 | 8.6 | 3.2 | 0.55 |
| LONG6 SURFACE | 9/28/2011 | 0.24 | 0.24 | 0.0092 | < | 0.160 | < | 14.6 | 7.1 | 1.5 |

## Sesachacha Pond

| Lab ID | Sample Date | Salinity (mg/L) | Particulate organic nitrogen (mg/L) | Nitrite (mg/L) | Nitrate (mg/L) | KJEHLDAHL NITROGEN (mg/L) | Ammonium (mg/L) | CHLOROPHYLL a (mg/L) | Pheophytin-a (mg/L) | Orthophosphate (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| SESA1 BOTTOM | 7/6/2011 | 13.8 | 0.14 | 0.016 | < | 0.090 | < | 10.9 | 2.4 | 0.76 |
| SESA1 BOTTOM | 8/31/2011 | 13.6 | 0.15 | < | < | 0.36 | < | 18.5 | 5.9 | 1.53 |
| SESA1 BOTTOM | 9/27/2011 | 13.7 | 0.13 | 0.004 | < | 0.16 | < | 8.3 | 3 | 3.1 |
| SESA1 BOTTOM | 6/16-6/17 | 13.8 | 0.23 | 0.003 | <0.05 | 0.210 | <0.05 | 12.2 | 4.9 | 0.44 |
| SESA1 SURFACE | 7/6/2011 | 13.8 | 0.28 | 0.008 | < | 0.14 | < | 12.5 | 2.5 | 0.67 |
| SESA1 SURFACE | 8/31/2011 | 13.6 | 0.16 | 0.0056 | < | 0.220 | 0 | 17.5 | 5.3 | 1.09 |
| SESA1 SURFACE | 9/27/2011 | 13.7 | 0.16 | 0.0042 | < | 0.240 | < | 8.9 | 3.2 | 1.99 |
| SESA1 SURFACE | 6/16-6/17 | 13.8 | 0.14 | 0.0042 | <0.05 | 0.190 | <0.05 | 11.4 | 3.6 | 0.41 |
| SESA2 BOTTOM | 7/6/2011 | 13.8 | 0.19 | 0.014 | < | 0.240 | < | 12 | 1.8 | 0.57 |
| SESA2 BOTTOM | 8/31/2011 | 13.6 | 0.13 | 0.0046 | < | 0.200 | 0.01 | 17.9 | 7.3 | 2.85 |
| SESA2 BOTTOM | 9/27/2011 | 13.9 | 0.1 | 0.16 | < | 0.060 | < | 10.6 | 2 | 1.96 |
| SESA2 BOTTOM | 6/16-6/17 | 13.9 | 0.14 | 0.0057 | <0.05 | 0.390 | <0.05 | 10.3 | 4.1 | 0.3 |
| SESA2 SURFACE | 7/6/2011 | 13.8 | 0.14 | 0.021 | < | 0.330 | < | 12.1 | 2.1 | 0.59 |
| SESA2 SURFACE | 8/31/2011 | 13.6 | 0.22 | 0.002 | < | 0.140 | 0.01 | 18.4 | 8.6 | 2.68 |
| SESA2 SURFACE | 9/27/2011 | 13.9 | 0.29 | 0.22 | < | 0.090 | < | 12.2 | 1.6 | 2.27 |
| SESA2 SURFACE | 6/16-6/17 | 13.8 | 0.16 | 0.0039 | <0.05 | 0.640 | <0.05 | 10.3 | 6.1 | 0.52 |
| SESA3 BOTTOM | 7/6/2011 | 13.8 | 0.14 | 0.042 | < | 0.640 | < | 12.2 | 1.2 | 0.49 |
| SESA3 BOTTOM | 8/31/2011 | 13.5 | 0.1 | 0.0023 | < | 0.09 | < | 16.7 | 6.2 | 2.89 |
| SESA3 BOTTOM | 9/27/2011 | 13.9 | 0.09 | 0.004 | < | 0.06 | < | 12.2 | 1.4 | 2.02 |
| SESA3 BOTTOM | 6/16-6/17 | 13.9 | 0.05 | 0.004 | <0.05 | 0.090 | <0.05 | 10.9 | 2.1 | 0.5 |
| SESA3 SURFACE | 7/6/2011 | 13.7 | 0.23 | 0.036 | < | 0.41 | < | 12.5 | 1.7 | 0.59 |
| SESA3 SURFACE | 8/31/2011 | 13.5 | 0.09 | < | < | 0.11 | < | 18.4 | 7.4 | 3.22 |
| SESA3 SURFACE | 9/27/2011 | 13.9 | 0.22 | 0.0031 | < | 0.11 | < | 11.7 | 2.2 | 1.81 |
| SESA3 SURFACE | 6/16-6/17 | 13.9 | 0.05 | 0.0046 | <0.05 | 0.05 | <0.05 | 11.2 | 3.6 | 0.38 |
| SESA4 BOTTOM | 7/6/2011 | 13.8 | 0.31 | 0.015 | < | 0.080 | < | 12.4 | 2.1 | 0.51 |
| SESA4 BOTTOM | 8/31/2011 | 13.4 | 0.14 | 0.0026 | < | 0.09 | 0 | 19.5 | 7.5 | 3.06 |
| SESA4 BOTTOM | 9/27/2011 | 13.9 | 0.15 | 0.006 | < | 0.05 | < | 11 | 2 | 1.83 |
| SESA4 BOTTOM | 6/16-6/17 | 13.9 | 0.1 | 0.0064 | <0.05 | 0.100 | <0.05 | 11 | 4.6 | 0.42 |
| SESA4 SURFACE | 7/6/2011 | 13.8 | 0.39 | 0.033 | < | 0.180 | < | 12.5 | 1.1 | 1.14 |
| SESA4 SURFACE | 8/31/2011 | 13.5 | 0.05 | 0.0044 | < | 0.14 | 0 | 17.4 | 7.1 | 3.04 |
| SESA4 SURFACE | 9/27/2011 | 13.9 | 0.17 | 0.002 | < | 0.05 | < | 10.2 | 1.9 | 3.52 |
| SESA4 SURFACE | 6/16-6/17 | 13.9 | 0.09 | 0.0064 | <0.05 | 0.110 | <0.05 | 11.3 | 4.2 | 0.52 |

## Miacomet Pond

| Lab ID | Sample Date | Salinity (mg/L) | Particulate organic nitrogen (mg/L) | Nitrite (mg/L) | Nitrate (mg/L) | KJEHLDAHL NITROGEN (mg/L) | Ammonium (mg/L) | CHLOROPHYLL a (mg/L) | Pheophytin-a (mg/L) | Orthophosphate (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| MP1 BOTTOM | 7/6/2011 | 0.2 | 0.19 | 0.02 | < | 0.240 | 0.27 | 11.9 | 2.8 | 0.46 |
| MP1 BOTTOM | 8/31/2011 | 2.5 | 0.29 | 0.0062 | < | 0.160 | 0.01 | 25.4 | 9.8 | 0.39 |
| MP1 SURFACE | 7/6/2011 | 0.2 | 0.14 | 0.0019 | < | 0.460 | 0.25 | 8.9 | 1.6 | 0.46 |
| MP1 SURFACE | 8/31/2011 | 1.9 | 0.14 | 0.0024 | < | 0.240 | 0.01 | 20.6 | 9.2 | 0.46 |
| MP2 BOTTOM | 7/6/2011 | 0.2 | 0.12 | 0.041 | < | 0.31 | 0.33 | 27.2 | 1.9 | 0.37 |
| MP2 BOTTOM | 8/31/2011 | 5.1 | 0.08 | 0.0048 | < | 0.250 | 0.05 | 16.2 | 7.3 | 2.17 |
| MP2 SURFACE | 7/6/2011 | 0.2 | 0.05 | 0.056 | < | 0.290 | 0.43 | 25.1 | 2.4 | 0.49 |
| MP2 SURFACE | 8/31/2011 | 1.4 | 0.08 | < | < | 0.13 | 0.02 | 20.1 | 8.6 | 0.13 |
| MP3 BOTTOM | 7/6/2011 | 0.1 | 0.21 | 0.011 | < | 0.260 | < | 7.6 | 2.1 | 0.39 |
| MP3 BOTTOM | 8/31/2011 | 2.2 | 0.18 | 0.0015 | < | 0.140 | 0.05 | 22.5 | 6.9 | 0.4 |
| MP3 SURFACE | 7/6/2011 | 0.1 | 0.14 | 0.022 | < | 0.430 | < | 7.4 | 1.5 | 0.33 |
| MP3 SURFACE | 8/31/2011 | 1.6 | 0.21 | 0.0027 | < | 0.180 | 0 | 15.5 | 4.2 | 1.06 |

# Hummock Pond

| Lab ID | Sample Date | Salinity (mg/L) | Particulate organic nitrogen (mg/L) | Nitrite (mg/L) | Nitrate (mg/L) | KJEHLDAHL NITROGEN (mg/L) | Ammonium (mg/L) | CHLOROPHYLL a (mg/L) | Pheophytin-a (mg/L) | Orthophosphate (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| HUM1 BOTTOM | 6/20/2011 | 2.1 | 0.07 | 0.0009 | <0.05 | 0.100 | 0.05 | 7.8 | 1.8 | 0.34 |
| HUM1 BOTTOM | 7/12/2011 | 1.8 | 0.26 | 0.0014 | 0.01 | 0.210 | 0.01 | 7.3 | 1.6 | 0.31 |
| HUM1 BOTTOM | 9/28/2011 | 4.7 | 0.16 | 0.0012 | < | 0.190 | < | 6.6 | 2.9 | 1.84 |
| HUM1 SURFACE | 6/20/2011 | 2.2 | 0.05 | 0.0024 | <0.05 | 0.110 | <0.05 | 7.3 | 2.4 | 0.36 |
| HUM1 SURFACE | 7/12/2011 | 1.8 | 0.31 | < | 0.01 | 0.140 | 0.03 | 7.2 | 2.1 | 0.14 |
| HUM1 SURFACE | 9/28/2011 | 4.6 | 0.22 | 0.0014 | < | 0.080 | < | 7.6 | 3.1 | 1.57 |
| HUM3 BOTTOM | 6/20/2011 | 2.1 | 0.06 | 0.0038 | <0.05 | 0.050 | <0.05 | 6.8 | 2.1 | 0.38 |
| HUM3 BOTTOM | 7/12/2011 | 1.8 | 0.33 | < | 0.01 | 0.16 | 0.01 | 7.1 | 2.4 | 0.26 |
| HUM3 BOTTOM | 9/28/2011 | 4.3 | 0.09 | 0.0018 | < | 0.220 | < | 13.4 | 3.9 | 1.51 |
| HUM3 SURFACE | 6/20/2011 | 2.1 | 0.05 | <0.0015 | <0.05 | 0.05 | <0.05 | 7.5 | 3.6 | 0.47 |
| HUM3 SURFACE | 7/12/2011 | 1.8 | 0.18 | 0.0009 | 0.01 | 0.090 | 0.01 | 6.8 | 3.9 | 0.01 |
| HUM3 SURFACE | 9/28/2011 | 4.1 | 0.13 | 0.0016 | < | 0.090 | < | 14.8 | 4.6 | 1.58 |
| HUM5 BOTTOM | 6/20/2011 | 1.5 | 0.05 | <0.0015 | <0.05 | 0.100 | <0.05 | 9.4 | 3.9 | 0.38 |
| HUM5 BOTTOM | 7/12/2011 | 1.1 | 0.29 | < | 0.02 | 0.050 | 0.05 | 13.3 | 6.2 | 0.11 |
| HUM5 BOTTOM | 9/28/2011 | 3.5 | 0.14 | 0.0016 | < | 0.050 | < | 20.7 | 7.3 | 1.52 |
| HUM5 SURFACE | 6/20/2011 | 1.5 | 0.14 | <0.0015 | <0.05 | 0.140 | <0.05 | 10.2 | 4.3 | 0.32 |
| HUM5 SURFACE | 7/12/2011 | 1.1 | 0.16 | < | 0.01 | 0.230 | 0.03 | 11.7 | 6.6 | 0.21 |
| HUM5 SURFACE | 9/28/2011 | 3.4 | 0.27 | 0.0018 | < | 0.130 | < | 21.5 | 8.6 | 1.93 |
| HUM7 BOTTOM | 6/20/2011 | 0.7 | 0.41 | 0.001 | <0.05 | 0.090 | <0.05 | 22.4 | 8.6 | 0.23 |
| HUM7 BOTTOM | 7/12/2011 | 0.6 | 0.23 | 0.0016 | 0.02 | 0.12 | 0 | 16.1 | 6.8 | 0.48 |
| HUM7 BOTTOM | 9/28/2011 | 2.1 | 0.29 | 0.0008 | < | 0.120 | < | 51.5 | 13.6 | 3.77 |
| HUM7 SURFACE | 6/20/2011 | 0.7 | 0.12 | 0.0001 | <0.05 | 0.05 | <0.05 | 20.2 | 10.1 | 0.54 |
| HUM7 SURFACE | 7/12/2011 | 0.6 | 0.34 | < | 0.01 | 0.140 | < | 17 | 7.1 | 0.26 |
| HUM7 SURFACE | 9/28/2011 | 2 | 0.29 | 0.0049 | < | 0.08 | < | 64.3 | 18.1 | 2.85 |
| HUM8 BOTTOM | 6/20/2011 | 1.3 | 0.08 | <0.0015 | <0.05 | 0.040 | <0.05 | 11.2 | 6.2 | 0.35 |
| HUM8 BOTTOM | 7/12/2011 | 0.9 | 0.18 | < | 0.02 | 0.050 | 0.1 | 19.6 | 8.1 | 0.22 |
| HUM8 BOTTOM | 9/28/2011 | 3.4 | 0.16 | 0.0044 | < | 0.090 | < | 21.2 | 6.7 | 1.68 |
| HUM8 SURFACE | 6/20/2011 | 1.2 | 0.05 | <0.0015 | <0.05 | 0.060 | <0.05 | 11.4 | 6.4 | 0.28 |
| HUM8 SURFACE | 7/12/2011 | 0.8 | 0.31 | < | 0.02 | 0.050 | 0.08 | 19.1 | 8.2 | 0.15 |
| HUM8 SURFACE | 9/28/2011 | 3.3 | 0.24 | 0.0065 | < | 0.110 | < | 25.5 | 8.1 | 1.83 |